Play Styles and Learning
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PLAY STYLES AND LEARNING

ABSTRACT

This chapter reviews player types found in commercial MMOs and educational games and a palette of Play Styles and Learning is proposed from which game designers and educators can more easily imagine (or perhaps "paint") their target audience. Two studies show how the palette might be applied. Study 1 examines the impact of different in-game reward schemas on player types. Study 2 compares classroom play with one child per computer versus paired play of the same educational game. Educational game design and the way a teacher structures in-class educational game play both influence emergent play and learning. Player archetypes (more commonly called player types) help game designers imagine the needs and interests of potential players. Considering learner types would be similarly useful. Learning styles relevant to educational game design and classroom use are described, including intrinsic and extrinsic achievement orientation, motivation, individual traits, and competition and other social factors.

INTRODUCTION

Different players play in different ways. Players are often characterized as either achievers or explorers (Bartle, 1990, 2006; Heeter & Winn, in press; Klug & Schell, 2006; Salen & Zimmerman, 2004). Multiplayer games introduce a social dimension, enabling pro-social and anti-social play styles. If their preferred play style is not available in a game, players must adopt a less preferred, available play style.

Different learners learn in different ways. Learners are often characterized by whether they learn better through visual, auditory or kinesthetic channels (Du*n*n, Dunn, & Price, 1984). Kolb's (1984) experiential learning styles are based on two axes, a preference for learning from concrete examples versus abstract concepts and from reflection versus action. If their preferred learning style is not available in a lesson, learners must adopt a less preferred, available learning style. Many factors encourage or inhibit learning, such as achievement orientation, self theories about learning, individual abilities, and the pleasures and complications of competition and other social dynamics of the circumstance of play and learning context.

Interface design guru Alan Cooper (1999) decries the vague goal of designing software for "the user." The word "user" is generic. It encompasses novice and expert users, children and the elderly, computer phobics and computer geeks. User is such an elastic concept it can "bend and stretch and adapt" (p. 127) to justify almost any design decision. Cooper's solution is to design for personas. Personas are tangible, carefully constructed archetypal users with particular needs and expertise, so specific they are even given a name and photograph. Design teams plan how their software will meet the needs of one or more specific personas. Instead of asking, "how would I use this software," personas help a design team ask "how would Mary [the primary persona] use this software" (Spool, 2007). Personas provide a common vocabulary for discussing, understanding, and designing for a tangible, less elastic target user.

Designing a game for "the player" is just as vague as designing software for "the user." The word player is amorphous, elastic, and each designer tends to imagine her or his own self as the

player. Some entertainment game design teams have begun to work with player archetypes (more commonly called player types) to focus the design process and to ensure that the game includes enough elements to appeal to each important player type (Klug & Schell, 2006). Entertainment player types are useful but not sufficient for educational game design. Because educational games have learning as well as entertainment goals, learning game player types need to incorporate player-learner characteristics such as learning styles, abilities, and achievement orientation.

In this chapter I review research on player types and learning to generate a palette of Play Styles and Learning. The palette serves as a reminder of the many different types of players and learners who might play an educational game. Designers can use the palette to focus in on the subset of player types and learning styles they want to consider, accommodate, and encourage in their game. Following the philosophy of persona analysis, it makes sense for a game to aim to please certain player types and learning styles very well rather than pleasing every type a little. Like an oil painter's palette, the Play Styles and Learning palette can be used to "paint" a vivid picture of specific target players.

The palette can help educators as they plan to use a game in their classroom. Reviewing the palette can be a reminder of player types and learning styles for whom the game is not optimal and who may need special attention. The circumstance of play can include pre-game activities, plans for playing in pairs or individually, and follow-up activities to address needs and interests of different kinds of learners.

The palette helps to focus my own research agenda and may be useful to other educational game scholars. I close the chapter by describing results from two studies that show how game design features including in-game rewards and circumstance of play can adapt to and even influence player types and learning styles.

BACKGROUND

Play Style and Player Types

Psychologists describe child play behavior based on laboratory observations of toy selection, rough-and-tumble play (or lack thereof), and activity level (for example, Alexander & Hines, 1994; Maccoby & Jacklin, 1987). Play style can be characterized as masculine or feminine. A feminine play style includes choosing feminine toys, an absence of rough and tumble play, and limited physical activity (Maccoby & Jacklin, 1987). But play style can be fluid. A child may move from one play style to another in a single period of play and may engage in different play styles on different days or in different contexts. Girls exhibit feminine play styles more often than boys do and vice versa, but both sexes engage in masculine and feminine play styles.

Like toys, digital games can be designed to offer more or less gendered game experiences by drawing upon masculine, feminine, neutral, or mixed themes, game goals, and player interactions. How a child actually plays with a toy is not always consistent with designers' intentions. One can practice juggling using three Barbie dolls or play house using marbles to

represent family members. Toy and game design restricts or enables different play styles, but ultimately the players decide how they will play from moment to moment.

Game research has looked at player types more so than play styles. Play style emphasizes behavior during play and tends to be viewed as fluid. Player types combine play style and player motivation, describing the player rather than transitory behavior. Player types are useful archetypes. Designers can consider game features and mechanics likely to appeal to a particular player type.

Player types have primarily been studied in the context of massively multiplayer online games (MMOs). Bartle (1990, 2006) was the first to develop a digital game player taxonomy, grouping players of an online "MUD" (a early form of multi-player online role play game, typically text-based) into four player types based on the kinds of pleasures they sought from playing. Two of the four player types (socializers and killers) are primarily driven by social interactions with other players. Socializers like to interact with other players, and killers like to frustrate and harm other players. Achievers and explorers are more interested in interacting with the game than with other players. Achievers seek to improve their power and status. Explorers delight in figuring out underlying game mechanics. They take pride in unearthing esoteric game features and bugs (Salen & Zimmerman, 2004).

Yee (2006) extended the study of MUD player types to look at types of motivations for playing MMOs. Collecting survey data from more than 30,000 players, he identified five underlying player motivations for their MMO play: Achievement, Relationship, Immersion, Escapism and Manipulation. Most MMO players were adults and 85% were male. Male players scored significantly higher on Achievement (the desire to become powerful in the game) and Manipulation (objectifying and using other players for one's own gain) factors, and female players scored significantly higher on Relationship (the desire to develop meaningful relationships with other players in the game).

Squire and Steinkuehler (2006) classified players in the Star Wars Galaxy MMO as role players and power-levelers. Power-levelers were motivated by achieving a-priori goals, often acquired through rote mechanical labor known as "grinding," while role players cared about moment to moment enjoyment in the game and tried to maintain the illusion and integrity of the virtual world and their character.

Klug and Schell (2006) describe nine player types used by some commercial game companies. An individual player often embodies a mix of two or more of these player types. Design teams creating massively multiplayer games work to ensure that different types of players can find enough to do in the game to keep them interested. (Note that designers are more likely to try to inhibit rather than accommodate killers or griefers.)

- Competitor (be better than the other players)
- Explorer (experience boundaries of the play world)
- Collector (acquire the most stuff)
- Achiever (championship over time, not just this round)
- Joker (fun and social)

- Director (thrill of being in charge)
- Storyteller (create or live in alternative worlds, build narrative)
- Performer (puts on a show)
- Craftsman (build, solve puzzles, engineer constructions)

What happens in a game is a result of the affordances and constraints of the game and the goals of the player.

By practical necessity, design decisions often end up privileging the goals of some player types and serving other player types less. Squire and Steinkuehler describe tensions between players with opposing goals when they posted feature requests about how to improve Star Wars Galaxy. Players with power-leveling, achievement goals wanted more pre-set story and clearly stated, fairly enforced standards for advancement. Players with a role play goal valued emergent play and freedom to invent their characters and actions.

Although narrower in scope and usually lacking the social dimensions of MMOs, educational games can elicit different play styles. Klawe, Inkpen, Phillips, Upitis, and Rubin (2002) observed that boys playing computer games in a museum exhibit hall were more interested in completing or winning and would "rush to beat the game" (similar to achiever player types in MMOs). Girls took a more exploratory approach (akin to the MMO explorers).

Ko (2002) looked at individual differences in how young people played an inferential problem solving game. He observed that some players appeared to be "random guessers" whereas others approached the game as systematic "problem solvers." Random guessing was not good for learning. The random guessers failed to improve over time, while the problem solvers' performance did improve.

Our own research (Heeter and Winn, in press) looked at player types in a single player educational game, based on data collected by the game during play. We created an online game for middle school students that teaches national science standards on evolution. Players earn points for each correct match and they lose points for each incorrect match. Players can be quick and efficient problem solvers, learning the minimum necessary to successfully complete each match. Or they can take their time and explore a wealth of interesting, related information not essential to matching correctly. It is possible to complete the game without paying any attention to the content by random guessing, although doing so would result in a poor score.

Based on what is known about player types we can expect to find achievers and explorers. Achievers want to succeed at the game. They probably also "rush to beat the game," playing quickly to finish before other students do, or even when playing alone, to make the experience more competitive. Explorers probably take their time and explore interesting content above and beyond what is necessary to complete the game.

When an educational game is a required classroom activity rather than a chosen leisure time pursuit, some students may go through the motions of playing without feeling motivated to achieve or explore. Lack of engagement with the game or lack of problem-solving ability could result in random guessing rather than problem solving play.

Ko (2002) classified players as problem solvers or random guessers. We divided problem-solvers into achievers and explorers based on how quickly they finished the game. We also used speed of play to divide random guessers into two player types. Those who played quickly and made many mistakes might be considered careless players. Those who played slowly and made many mistakes might be thought of as lost. Table 1 shows the four player types (Achiever, Explorer, Careless, and Lost) and how those player types would be classified based on their score in the game and how quickly they finished.

Table 1: Learning Game Player Types

	ACHIEVER	EXPLORER	CARELESS	LOST
SCORE	High	High	Low	Low
TIME	Fast	Slow	Fast	Slow

Table 2 shows actual play behavior of the four player types, using data collected online from 90 seventh graders' in-class play of Life Preservers, a science education game we created for play style research (Life Preservers, 2006). The fastest 50% of players were classified as fast. The slowest 50% were categorized as slow. The 50% who made the fewest mistakes were high scorers. The bottom 50% were low scorers.

Table 2: Play Behavior by Player Type

	Achiever	Explorer	Careless	Lost	p	ANOVA
PLAY STYLE						
Minutes	7.0	13.0	7.0	13.0	.000	F=45.50; df=3,86
# Mistakes	3.8	5.6	18.9	19.4	.000	F=19.61; df=3,86
Click Rate	10.1 per minute	5.7 per minute	10.0 per minute	5.5 per minute	.000	F=15.38; df=3,86
N	25	23	19	23		

As would be expected based on how the categories were constructed, Achievers and Careless players finished much faster than Explorers and Lost players. Achievers and Careless players played the fastest, finishing in an average of 7 minutes. Explorers and Lost players took almost twice as long to play, an average of 13 minutes. Achievers and Careless players clicked much more often – an average of 10 clicks per minute of play versus Explorers and Lost players' rate of about 5.6 clicks per minute.

Explorers and Achievers made similarly few mistakes in the game (an average of 3.8 to 5.6) while Lost and Careless players averaged nearly four times that many mistakes (around 19). Careless players clicked quickly but may not have stopped to read. Lost players seemed to take time to read but still made many mistakes. Based on their play behavior, Lost players appear to be the least engaged with both game play and content of the four player types.

Which of those four player types learned the most? Does a high score in the game equate with more learning? Before answering those questions, we will consider research on learning that might be relevant to game design in general and educational game design in particular.

Learning Orientations and Learning Styles

Gee (2007) marvels about how directly great games resemble great pedagogy. Among other parallels he points out that games are "action-and-goal-directed preparations for, and simulations of, embodied experience" (p. 26). He explains that players gain competence through trial, error, and feedback. Game design for player enjoyment and instructional design for student learning both deal with motivation, challenge, individual differences, and social interactions. This section reviews some of the cognitive psychology and learning research, which has direct implications for learning game design.

Intrinsic and Extrinsic Achievement Orientation

Achievement or goal orientation refers to how individuals perceive and respond to achievement situations (Dweck & Leggett, 1988). People who have a high achievement motivation enjoy challenges much more than those with a low achievement motivation (Lee, Sheldon, & Turban, 2003). Students' motivation to achieve at school can be based on extrinsic goals external to the learning content such as earning good grades or teacher approval. Intrinsic goals internal to the act of learning can also motivate learning, such as the pleasure of mastering a new topic or content being learned, curiosity about the subject matter, or the sense of expertise as knowledge grows. Intrinsic rewards arise from the process of learning or play and extrinsic rewards from results (grades, points, winning, approval). Chang (2004) found males and females are equally high on the intrinsic motivation to achieve (i.e. mastery of skills and knowledge), but females also tend to work for grades for social purposes. Unfortunately, researchers observe a steady decline in intrinsic motivation as children progress through school, and some developmental decrease in extrinsic motivation.

Lepper and Henderlong (2000) reviewed decades of research examining the relationship between intrinsic and extrinsic motivation. Under some circumstances, offering extrinsic rewards reduces intrinsic motivation, particularly if the extrinsic rewards are unrelated to the learning task. For example, teachers who overemphasize grades may reduce their students' intrinsic motivation. But studies have also shown that extrinsic rewards do not necessarily interfere with intrinsic motivation and can in fact complement them. Rewards tend to enhance motivation when they provide information about competence but undermine motivation when they serve only to assign status (Lepper & Henderlong, 2000). For example, there is a positive correlation between curiosity about a topic (intrinsic) and attempting to please the teacher (extrinsic).

Achievement orientation dovetails with achiever and explorer MMO player types, and also explains the underlying motivation why players exhibit one or the other play style. Achievers and power-leveler player types clearly are driven by extrinsic rewards defined by the game rewards. Explorers and role players are more motivated by intrinsic aspects driven by personal interest and curiosity. Extrinsic rewards in a game include points, leveling up, completing quests, and collecting items. Intrinsic rewards in a game are based on player interests and

feelings, such as curiosity, exploring the world, and mastering challenges to enjoy the process of mastery.

Learning motivations and game play motivations may or may not be closely aligned. This depends in part on the game design. When learning how to play and playing an educational game are closely tied to the desired learning outcomes, then a players' learning goals and game goals can likewise be closely aligned. For example, in a game designed to teach about microbial antibiotic resistance, the player is challenged to find ways to reduce hospital transmission. Winning requires players to learn about microbes and apply their new knowledge. Conversely, if game play and learning content are weakly linked, the player may have separate intrinsic or extrinsic goals for game play and for learning. For example, if a math game involves shooting the right answer a player may find intrinsic pleasure in shooting within the game (game mechanics) but may feel no intrinsic interest in math (learning goals).

Intrinsic and extrinsic motivations in an educational game have implications for play style and game design. Beswick (1971, 1974) found that intrinsically motivated individuals need time to explore. He explains that intrinsically motivated individuals "tend be more aware of a wide range of phenomena, while giving careful attention to complexities, inconsistencies, novel events and unexpected possibilities. They need time and freedom to make choices, to gather and process information, and have an appreciation of well finished and integrated products, all of which may lead to a greater depth of learning and more creative output" (Beswick, 2007, p.1). Players who are intrinsically motivated will notice more detail and need more time to explore. Extrinsically motivated players seek external rewards such as winning and achievement. Games which force all players to hurry or which require them to follow only a single prescribed path, are at odds with intrinsically motivated learning and play style.

Mindset and Self Theories

Intrinsic and extrinsic motivations can both fuel learning. However some goal orientations inhibit learning. Dweck (2000, 2006) studies the impact of mindset on academic achievement and reaction to challenge. Mastery goals refer to a focus on skill development and task mastery and an attempt to meet personal standards of accomplishment. By contrast, performance-oriented goals focus on obtaining favorable evaluations from others. VandeWalle, Brown, Cron, and Slocum (1999) found that a mastery goal orientation (but not a performance goal orientation) resulted in skill building, which led to greater performance.

Elliot and Church (1997) considered two quite different reasons individuals may have for pursuing performance goals. Performance-approach goals involve displaying competence and earning a favorable judgment. Performance-avoiding goals focus on trying to avoid failure. Elliot and Church found positive outcomes for both the performance-approach and mastery goals including positive emotions and absorption in the given task. Performance-avoidance prompted efforts to escape potential consequences of failure and was associated with anxiety. Performance-avoidance interfered with mental focus, blocking the individual's ability to concentrate and become absorbed in an activity. The performance-approach and the mastery goals approach enhanced mental focus.

Dweck (2006) found that about 42% of the population has a growth, or mastery mindset. These people believe that intelligence is malleable, that they are capable of improving. Another 42% of the population holds a fixed or helpless mindset. They believe that intelligence is fixed and cannot improve. A fixed mindset "creates an urgency to prove yourself over and over" (Dweck, 2006, p. 6). A fixed mindset can undo a natural love of learning. In contrast, effort and learning make incremental students feel good about their intelligence; easy tasks waste their time rather than raising their self-esteem. Those with a helpless mindset fit Elliot and Church's classification of performance-avoidance. They avoid situations that they cannot easily do well at. Failure undermines their confidence and they become depressed and ineffective. Dweck (2006) suggests females may be more vulnerable to criticism because they encounter less of it during childhood.

People can have different mindsets in different areas. They may have a mastery mindset in some domains and a helpless mindset in other domains. Players with a mastery mindset related to games will enjoy challenging games and be motivated by feedback including failures. Players with a helpless mindset, if they play games at all, will shrink from hard challenges and try to avoid situations in the game where they might fail. They likely also will prefer to play alone, where failure is not as public.

Mindsets can change. Dweck (2006) proposes that the nature of feedback and rewards can encourage or discourage a mastery mindset. This advice applies both in the classroom and in games. Teachers and game designers should emphasize learning goals and encourage learners/players to view both gaming and subject matter as domains they can master.

Gee (2007) points out that the role of failure in video games is much different than the role of failure in schools. Failing in a game is part of the learning process – the player can start over, take risks and test hypotheses, all contributing to their learning. Learning through failure is great for players with a mastery mindset and problematic for players with a fixed mindset. In-game messages could be designed to help foster a mastery mindset, reinforcing the idea that every player's skill and "intelligence" can improve through play.

Inhibiting or Enhancing Intrinsic Motivation

Research on learning points to ways of teaching that should improve a learner's intrinsic motivation to learn. These methods apply equally well to designing engaging games as to motivating classroom learners to learn. As Gee (2003, 2005, 2007) explains, game design in many ways parallels cutting edge research on learning.

Here are four suggestions for increasing motivation and learning in the classroom, based on learning research. Each has implications for learning game design. Steps to promote curiosity include:

1.) Personalize an educational activity in terms of themes, objects, and characters of high prior interest to students should enhance intrinsic motivation
2.) Tap an existing interest outside of the classroom
3.) Situate the learning in meaningful and interesting contexts

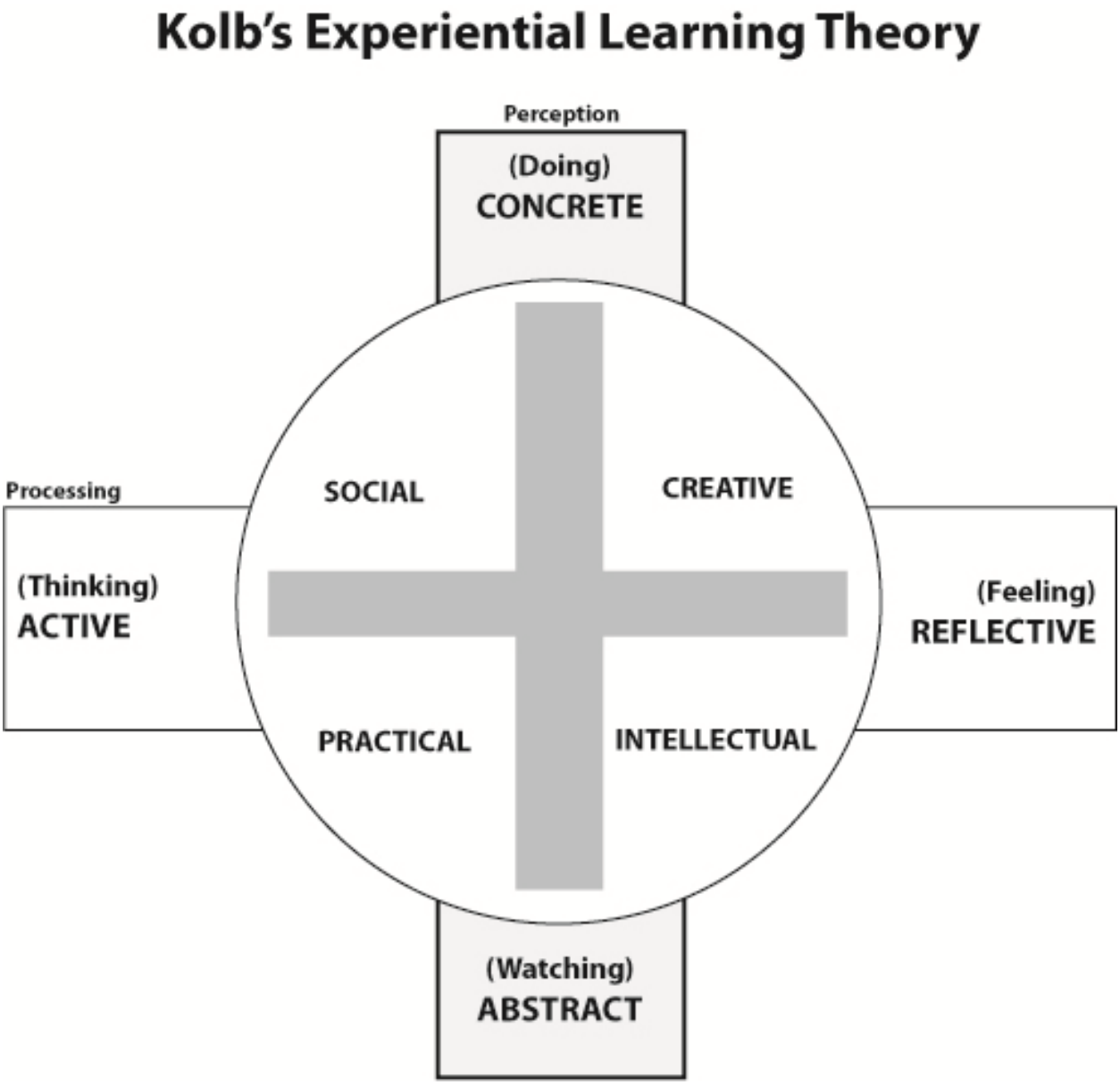
4.) Structure an appropriate level of challenge (not too much, not too little) increases motivation, a state Csiksentmihalyi (1990) refers to as “flow” and Gee (2007) describes as “pleasant frustration.”

Learning Style Theories

Various learning style schemas can be applied to analyze the match between how learning opportunities are presented and what would be ideal for individual students. Dunn, Dunn, and Price (1984) classify learners as preferring to learn through visual (seeing), auditory (hearing), or kinesthetic (doing) channels. Educators are advised to include teaching materials that address different senses, to reach diverse learners.

Kolb’s (1984) Experiential Learning Theory considers the intersection of two constructs: perception and information processing. The perception axis ranges from a preference for concrete experience to its opposite, a preference of abstract conceptualizations. The processing axis ranges from active experimentation to reflective observation. The coordinate system yields four learning styles. Schaller, Borun, Allison-Bunnel and Chambers (2007) applied Kolb’s theory to online learners' preferences for, and responses to, different types of activities (Figure 1). They renamed the axes “doing” or “watching” and “feeling” or “thinking.” Some players prefer to learn by watching, others by doing. Some seek concrete experiences; others prefer abstract concepts.

Figure 1: Adaptation of Schaller, Boron, Allison-Bunnel, & Chambers’ Adaptation of Kolb’s Experiential Learning Theory



When learning game affordances (possible ways of playing and learning) match the preferred learning style of the player, there may be a stronger learning outcome or at least a more pleasant, easier learning process. Because different players have different preferred learning styles, games for a diverse audience should consider incorporating learning content and activities suited to more than one learning style.

Individual Traits

Individual traits such as gender and age have implications for creation and use of educational games. For example, Piaget's (1954) stages of cognitive development in children and teenagers include the sensory motor period (0 to 24 months), Preoperational (2 to 7 years), Cognitive Operational (7 to 11 years), and Formal Operational (11 to 15 years). Educational games target age-appropriate cognition. Hundreds of studies have found gender differences related to gaming

or computing (for a recent review see Kafai, Heeter, Denner, and Sun, in press and for an extensive collection visit the "investiGaming" online knowledgebase, 2007). Game designers can anticipate and design for gender differences.

A challenge to teachers and game designers is optimizing learning experiences for individuals with differing abilities and experiences. Gardner (1983, 1993, 2000) introduced the concept of multiple intelligences: linguistic, logic-mathematical, visuo-spatial, body-kinesthetic, musical, interpersonal, intrapersonal, and natural (of nature). Fitting challenge to ability is one of the keys to both learning and engagement. Each player-learner brings a unique mix of abilities to the game or class. Van Eck (2006) discusses the potential for creating intelligent games that adapt to individual players' needs.

Another way individuals differ is along Vygotsky's (1978) concept of a learner's "zone of proximal development" (ZPD). Some activities (physical or mental) are completely within the ability of the learner to accomplish on their own. Some activities are completely beyond the ability of the learner to accomplish regardless of whatever assistance might be given them. Somewhere in between these two extremes lie tasks the learner is capable of doing with some assistance from adults, from more competent peers, or perhaps from characters in a game. Vygotsky believed that this area, or zone, is where learning occurs.

To guide, encourage, and keep pace with players' constantly evolving ZPDs, games often include carefully constructed levels of progressive difficulty so that players must master one subset of skills before advancing the next level. Games also often provide hints to help advance the game, either directly (through characters or game hints) or indirectly. Hints and levels serve as scaffolding for new learning (Lepper, Aspinwall, Mumme, & Chabay, 1990).

Competition and Other Social Impacts on Play Style and Learning

The social dimension of gaming is central to two of Bartle's four player types (Killer and Socializer) and to five of Krug and Schell's nine player types (Competitor, Director, Performer, Storyteller, and Joker). Social aspects of multiplayer games are far from universally positive. Bartle's "Killers" or what Yee called "Griefers" refer to anti-social players who take sociopathic pleasure in interfering with the play and enjoyment of others. Cyberbullies and killer players are not motivated by learning goals themselves, and they impede learning for other players. Krug and Schell's Joker may be harmless in a commercial MMO, but in a classroom or learning game their goal of being funny or silly may get in the way of their own learning and may distract others.

Playing with other people is an important part of the fun in many games. Lazzaro (2004) identified "People Fun" as "the enjoyment from playing with others inside or outside the game coming from the social experiences of competition, teamwork, as well as opportunity for social bonding and personal recognition that comes from playing with others." Lazzaro's advice to game designers is to "create opportunities for player competition, cooperation, performance, and spectacle."

Social interaction around classroom games can occur in different ways. Massively multiplayer learning games such as Quest Atlantis assign each student to a computer (Barab, Thomas, Dodge, Carteaux, & Tuzun, 2005). Learners solve quests together within the game world. The Great Solar System Rescue is played in 5 person teams, with one computer per team (Jackson, 1997). Single player learning games can be played in teams or pairs, with players sharing a single computer and planning game play moves together. Social interaction before and after a game can build upon people fun, cooperation, and competition.

Pro-social, people fun sometimes contributes to learning and sometimes detracts from learning in school settings and in games. Those who are motivated by extrinsic, performance-approach goals are likely to enjoy a social context where they perform learning. Sherry, Lucas, Greenberg, and Lachlan (2006) found one of the most frequently cited reasons for playing video games was to prove to other people who has the best skills and can react or think the fastest. This response typically came from male respondents, "paralleling the dominance display among males most often seen in sports to establish a relative position in the person's group hierarchy" (p. 217). Durkin (2006) reports similar gender differences: boys like to share games with their peers, and girls' reactions range from lack of interest, through spectator roles, to enthusiasm. Competition in multiplayer games adds motivation and enjoyment for some players but interferes with motivation and enjoyment for others.

Playing games in a mixed gender classroom setting can exacerbate the impact of gender, presenting girls with potential barriers to learning (Heeter & Winn, in press). Bertolozzi (2006) found males seek to play with males and females with females in part because single gender playgrounds are arenas in which players feel somewhat freed from having to deal with the complexities of cross gender interactions which affect every other area of their lives. Several experiments have showed competition improves performance relative to a noncompetitive environment for boys, but not for girls, with the result that competition increases the performance of males relative to females (Gneezy & Rusticini, 2004; Gneezy, Niederle, & Rusticini 2003).

Girls playing games in a mixed gender group experience not only the complexity of competing against males but also negative stereotypes about their gaming prowess. Both computers and games are predominantly masculine-associated domains. Boys tend to dominate the technology (Ching, Kafai, and Marshall, 2000) while girls tend to deprecate their own competence and abilities (Jensen and de Castell, 2005) in mixed gender, computer gaming environments. Jensen and de Castell (2005) found girls and women characterized their own game play as being inadequate and/or less competitive for reasons which made little or no sense in relation to their own lives and experience. Young women constructed similar excuses as to why the boys in their classroom tended always to monopolize the best machines

Steele (1997) developed the term "stereotype threat" to describe the experience of when stereotypes about a group's abilities affect their intellectual identity and performance in certain social situations. Other researchers have documented this impact. Dweck (2006) found "when stereotypes are evoked, they fill people's minds with distracting thoughts – with secret worries about confirming the stereotype. People usually aren't even aware of it, but they don't have

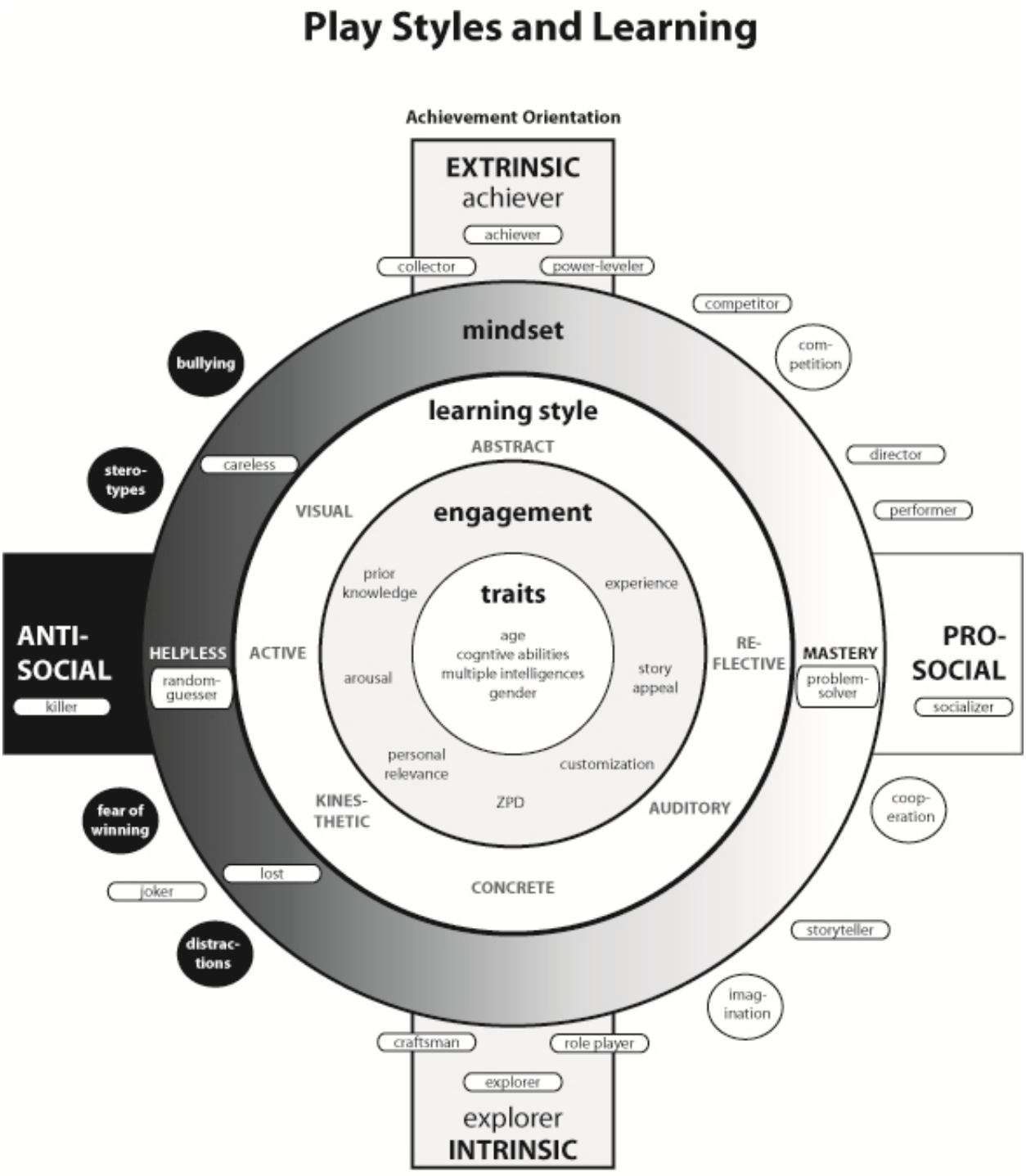
enough mental power left to do their best on the test“ (p. 75). Self-consciousness about negative stereotypes reduces mental focus and interfere with concentration and performance.

Of course, there are many positive aspects of group play and collaborative learning. Looking at commercial games, Lim and Lee (2007) found that co-playing led to a significant increase of the player's physiological arousal during nonviolent game play. Furthermore, co-playing enhanced the player's sense of presence and identification. Some learning games are designed as multiplayer experiences. Pedagogical arguments in favor of team rather than individual learning games derive from collaborative learning research which shows that "students working in small groups tend to learn more of what is taught and retain it longer than when the same content is presented in other instructional forms" (Gross Davis, 1993). When students are put in learning situations where they must explain and discuss their beliefs, some of their thoughts become more clear and others may be challenged by peers or a teacher (Linn & Burbules, 1991).

A Palette of Play Styles and Learning

Figure 2, Play Styles and Learning, presents a palette integrating all 52 elements discussed in the literature review. Seventeen player types appear in round rectangles; 13 outside of 4 within the outer (mindset) ring. Two motivation axes, achievement orientation and social orientation underlie player types and learning styles. Player-learners may have strong or weak motivations along any combination of intrinsic and/or extrinsic achievement orientation and pro-social or anti-social people orientations. Player types are archetypes. Real players often adopt two or more styles.

Figure 2: Play Styles and Learning Palette



Not all possible play and learning styles are effective for learning. Anti-social goals interfere with the player's own or other players' learning and enjoyment. Also, a helpless mindset hinders engagement with challenge and inhibits learning. Six game-related motivations are in the palette, placed close to the motivation axes they are most often associated with. Bullying and negative cultural stereotypes about a player-learner's abilities interfere with learning. Reluctance to be singled out as the winner and social distractions also get in the way of learning. On the bright side, enjoying competition contributes to extrinsic achievement, cooperation is associated with pro-social enjoyment, and imagination is one form of intrinsic pleasure.

Three rings and an inner core highlight 24 important learner characteristics. Mindset, the outer ring, can be helpless or mastery. Learning styles include visual-auditory-kinesthetic predilections as well as concrete-abstract and reflective-active experiential learning preferences. Engagement is influenced by prior knowledge, personal experience, and personal relevance, a learner's ZPD and arousal during play and the appeal of the story/content. Player traits likely to be relevant to game design and learning include age, gender, cognitive abilities and multiple intelligences.

RESEARCH ON PLAYER TYPES, EDUCATIONAL GAME DESIGN, AND CLASSROOM GAME USE

Learning motivations and styles have been studied for decades but research on player types and learning from games is sparse. The Play Styles and Learning palette is intended for game designers and teachers who want to teach with games, to focus attention of important design features, player-learner behaviors, and learning. The palette can also helps focus and target research. To close this chapter I will describe two of my team's own experiments, which examine the impact of in-game reward structure (game design) and paired play (structuring classroom use of a game) on player types and learning.

Manipulating Play Style Through Reward Structure

In my review of Player Types, I proposed four educational game player types (Achievers, Explorers, Careless players and Lost players). Game designers decide how points are awarded, how players compete and win, whether and why bonus points or other rewards are awarded. Our study looked at the impact different reward conditions had on player types and learning.

We created three versions of the Life Preservers game which were identical except for bonus points. The "plain" version had no bonus points. A second version rewarded speedy play. A countdown clock was shown for each round. Players who finished before the clock ran out won "speed bonus points." The third version rewarded exploration. A "critters explored" counter kept track of how many different critters the player explored for at least 7 seconds each during a round. Bonus points were awarded for each critter explored.

Data was collected as 270 seventh graders played LP online, with one child per computer, during part of normal class activities. When a player logged in, they were randomly assigned to one of the three versions of the game. Ninety players played the no bonus version, 92 played the Reward Speed version and 98 players played the Reward Exploration version. (For more detail

about the game and the research please see Heeter & Winn, in press.) Online survey data, including a post-test and attitudinal measures was also collected for 230 of the 270 participants. (Technical problems interfered with survey completion from 40 students.)

To classify player types, the same method and cutoff percentiles described for Table 2 (which presents only the 90 players in the No Reward condition) were applied to players of all three versions. Table 3 combines all three reward conditions and shows perceived fun, gender, mistakes, and performance on a knowledge post-test by player type.

Table 3: Learning, Fun and Gender by Player Type

	Achiever	Explorer	Careless	Lost	n	p	ANOVA
Perceived Fun	3.1	3.2	2.6	2.7	230	.029	F=3.07; df=3,227
% female	41%	49%	44%	68%	270	.008	F=3.99; df=3.265
# Mistakes	4.5	5.4	21.1	19.2	270	.000	F=64.41, df=3,266
Learning	7.5	6.8	6.5	5.7	230	.002	F=5.02; df=3,227

Players rated how fun LP was to play, on a scale from 5 = very fun to 1 = not fun at all. Achievers and Explorers rated LP as significantly more fun than did Careless and Lost players. Sixty-eight percent of Lost players were female, despite a 50-50 gender split in the study sample. Females were proportionately underrepresented in the Achiever and Careless player types. Gender differences were statistically significant.

Looking only at mistakes made during play (the Mistake averages in table 4 combine players in all three reward conditions), Achievers and Explorers made far fewer mistakes. Achievers and Explorers would seem to be the best learners. An 11 item post game knowledge test was based on items from standardized tests to assess national science standards related to evolution and adaptation. The questions assess general concepts, rather than specific details about any of the creatures included in LP. Achievers scored the highest (7.5 out of 11), and Lost players the lowest (5.7). Explorers and Careless players scored almost the same on the knowledge post-test, despite vastly different numbers of mistakes during play (6.8 and 6.5, respectfully).

Unfortunately the knowledge test failed to measure any of the interesting facts and observations Explorers may have learned, for example facts about actual prehistoric creatures, that went beyond the broad concepts tested by the exam. My own goals as a teacher are to inspire learners' intrinsic interest in the topic, and my hope is they go beyond only learning what will be on the test. On the other hand, we have a K-12 system oriented towards "teaching to the test" (Posner, 2004). Based on goal of maximizing scores on standardized tests, Achievers appear to be the best player type for learning, slightly, although not significantly, better than Explorers. By both measures (in-game errors and post game knowledge), Lost players learned the least. Reducing the number of Lost players, either through game design or classroom intervention, could benefit learning.

Table 4 shows the percent of Achievers, Explorers, Careless and Lost players in the three reward conditions. Comparing the No Bonus condition to the Reward Exploration condition, the most notable and predictable difference was an increase in Explorer player types. Comparing the No

Bonus condition to the Reward Speed condition, fewer players (only 15%) were classified as Explorers and increases in the number of Careless and Lost players were observed. This makes sense. Rewarding speedy play causes players to play faster. Achievers DID NOT increase. In other words, playing faster did not equate to playing better.

Table 4: Player Type by Reward Condition

REWARD STRUCTURE	Achiever	Explorer	Careless	Lost	N
No Bonus	28%	26%	21%	26%	90
Reward Speed	26%	15%	28%	30%	92
Reward Exploration	25%	34%	21%	21%	98
N	71	67	63	69	270

Rewarding speedy play seems to interfere with learning for some players. Rewarding exploration resulted in the lowest percentage of low scores. Learning games should try to minimize Lost play. The results from the knowledge post-test suggest more research is needed on learning by Careless players. Mistakes made within the game may or may not be a good measure of learning.

Play styles and Learning in Solo versus Paired play

Game design can influence play style and learning. So can the circumstance of play (the context in which educational games are played). We conducted an experiment with Life Preservers to increase social interactions during this single player game. Paired play introduced a social dimension, increasing the likelihood of pro-social and anti-social play. Benefits for learning could come from competition or cooperation. Potential drawbacks include bullying, added distractions, stereotypical expectations (such as girls being self consciously aware of an expectation that girls are bad at games) that interfere with concentration, and what the palette labels "fear of winning," when competition instills a desire not to win. Extensive research points to gender as an important consideration in group play (for example, see Jensen & de Castell, 2005).

Williams & Kessler (2002) studied paired programming assignments in computer science. Pairing programmers of roughly the same ability was most beneficial in part because it reduced disagreements over irrelevant details. In general homogenous pairings were best, including pairing extroverts with extroverts and introverts with introverts. There were too few female computer science students to analyze gender. Werner, Denner, and Bean (2004) structured paired programming among middle school girls. Their work found strong benefits for paired programming among girls, with ground rules to facilitate teamwork.

One hundred fifty-six seventh graders (79 girls and 77 boys) from one Indiana city and one California city played in teacher-assigned pairs. The teacher randomly assigned each child to either a same gender or mixed gender team, seeking an equal number of boy-boy, girl-girl and girl-boy teams. Werner, Denner, and Bean's (2004) guidelines for paired programming were adapted to paired play. One player was assigned to control the mouse for the first round. The

game then instructed the pair to switch seats and hand off the mouse for the next round. The partner who was not controlling the mouse was assigned to watch and provide guidance and help minimize mistakes. In total, online play data was recorded for 21 all girl pairs, 20 all boy pairs and 24 mixed gender pairs who played the game. Play style data from each pair was compared with individual play style from the 90 seventh graders (42 girls and 48 boys) in the earlier solo play study, looking only at those in the no bonus rewards condition.

Table 5 compares solo and paired play by gender and player type. Looking at click rate (clicks per minute), the average click rate for solo boy players was 9.8 clicks per minute, and for solo girls it was 6.8 clicks. Paired play click rates were the same for girls whether they played in girl-girl pairs or alone (6.7 or 6.8). Boy-boy pair click rates were much slower than boys playing alone (6.9 compared to 9.8). Mixed girl-boy pairs had the slowest click rate (5.7 clicks per minute). ($F=3.31$, $df=4,150$, $p=.022$)

Table 5: Play Styles Influenced by Solo or Paired Play (plain reward structure)

	Achiever	Explorer	Lost	Careless	n
Girls					
Solo	16.7%	23.8%	42.9%	16.7%	42
Pairs	20.0%	25.0%	40.0%	15.0%	21
Boys					
Solo	37.5%	16.7%	18.8%	27.1%	48
Pairs	19.0%	**47.6%**	19.0%	14.3%	20
Mixed					
Pairs	8.3%	25.0%	**50.0%**	16.7%	24
Overall					
Solo	27.8%	20.0%	30.0%	22.2%	90
Pairs	15.4%	32.3%	36.9%	15.4%	65

Girls playing alone and girls playing in girl-girl pairs each exhibited a similar distribution of play styles (see Table 5). The most common player type for girls was Lost (slow play with many errors) accounting for 43% of solo and 40% of paired girl players. The second most common girl player type was Explorer, accounting for 24% of solo and 25% of paired girl players.

Boys playing alone were most often classified as Achievers (37.5%). When boys played in boy-boy pairs, their style was different, most likely to be Explorer (47.6%). Playing in pairs slowed boys down. Careless play dropped from 27% among solo boy players to 14% among paired boy teams. Differences in play style were significant based on crosstab analysis, with Chi-square=23.38, df=12 and p=.025.

Mixed girl-boy pairs showed the highest proportion of Lost play. Half of all mixed gender pairs fit that classification.

Paired play appeared to have beneficial impacts on some players' attention to the game's learning content. Under solo play conditions, a subset of players made more mistakes than correct matches; a different subset explored very few creatures. Paired play resulted in less

variance for mistakes (as well as significantly fewer mistakes) and less variance for creatures explored (as well as slightly, but not quite significantly, more exploration). Paired play was particularly good for boys paired with another boy. On average boys playing together scored higher, and played a little slower than boys playing solo. Paired play was neither particularly good nor bad for girl-girl teams. Play style of two girls playing together strongly resembled play style of one girl playing solo in terms of play style, mistakes, and exploration. Girl-boy pairs seemed to suffer rather than benefit from the pairing. This combination resulted in more Lost play style than other pair groups.

IMPLICATIONS OF THE PLAY STYLES AND LEARNING PALETTE

The palette serves as a reminder of many dimensions of play and learning. It can be used like an artist's palette of colors from which to paint a picture of target player types for a game at early stages of development. (The diagram can be downloaded from http://gel.msu.edu/palette/) Designers, teachers, and playtesters are invited to print out a copy or download and modify the source file. Use it to highlight learning styles and player types the game will be designed to serve and to envision and prioritize primary and secondary target players (player personas). How might secondary player goals also be met to some extent? Looking at achievement orientation, can achievers achieve and explorers explore? Are in-game rewards and feedback presented in a way that promotes a mastery rather than performance mindset?

Playtest researchers might use prioritized palette printout for each player they observe, using it to focus observations on areas of concern during design. Educators who structure the circumstance of play for classroom learning with games could use the palette to consider how to build upon the game experience through pre- and post- activities to enhance learning for different learner needs and interests.

Using player types and learning styles as a lens for designing, teaching with, and studying games for learning draws attention to underlying reasons for effective games. Doing so could help designers and theoreticians envision what effective play styles for learning might look like, and imagine tangible ways to encourage desired kinds of play.

Use the palette to evaluate the type of players that you need to design for and what designing for those player-learner types means. Think about and create a persona for your target player-learners using the palette as your guide. As found in the Life Preservers examples, game design can influence play style and learning. For our player-learners, it was found that the game would encourage more learning if there were no speed incentives. Achiever player types naturally motivated themselves to be fast and adding mechanisms to motivate speed did not have a great impact on how the Achievers played. However, adding speed incentives did negatively impact other player types, in terms of both the learning the player got out of the game and their perceived fun. Rewarding exploration in the game helped to decrease the number of lost player types in the game and resulted in the lowest percentage of low scores. Learning games should try to minimize Lost play. Use the palette to think about the player-learners of your game and design it with features that will help them to learn more and enjoy it more.

The palette's use transcends the game design phase and can be used to create a better experience for the player-learners using the game. The Life Preservers study found pairing students together in same-gender teams can be beneficial. On average boys playing together scored higher than boys playing solo and there was no effect on girls performance when comparing all-female paired play versus solo female play. Mixed-gender teams hindered the students performance, as this combination resulted in more Lost player types than other pair groups.

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KEY TERMS

Term 1- Player Types

Definition: Player types are archetypes of extreme player behavior characterized along observable, meaningful dimensions. Play styles are different ways of playing (such as masculine and feminine play styles). Player types are different kinds of players. Player types embody essential, prototypical player behaviors. This chapter links player behavior and underlying motivations in describing different player types, as a means to facilitate game design for different player types. In practice, individual players often exhibit characteristics of two or more player types at different times.

Term 2- Achievement Orientation

Definition: Achievement or goal orientation describes how individuals perceive and respond to achievement situations such as learning, classroom performance, or game play. Individuals may be intrinsically motivated by the pleasure of mastering a new topic or content being learned, curiosity about the subject matter, or the sense of expertise as knowledge grows. Or they can be extrinsically motivated by grades, teacher approval, earning points or money, finishing first, or being recognized as the best.

Term 3- Learning Game Affordances

Definition: Learning game affordances are the kinds of actions and perceptions a player-learning recognizes as being available at any given time within a game, including available learning styles and available play styles. Affordances are based on how the game was created (intended

affordances) as well as player knowledge, experience, and imagination and how clearly what is possible is communicated to the player. In addition to intended affordances, some games also enable player-generated content and goals whereas other games are much more narrow in what is possible.

Term 4 - In-game Rewards

Definition: The payoffs a player can earn during a game such as points, leveling up, acquisition of special powers or collecting objects are means by which game designers can encourage or discourage player behaviors and attitudes. In-game rewards can be designed to encourage growth mindsets and facilitate intrinsic motivation, or they can inhibit exploratory play and reinforce a helpless mindset.

Term 5 – Personas

Definition: Personas were developed by user interface designers to overcome problems associated with designing for the vague, elastic construct of "the user." A personas is a user or player archetype, conceptualized as if he or she were an actual person, with a name, goals, needs, and experience (or lack thereof). Personas are used by design teams to conceptualize and discuss a shared vision of a tangible primary and secondary target audience.

Term 6- Social Player Types

Definition: The social to antisocial dimension of player types describe individuals whose predominant pleasure from playing stems from interactions with other people. Anti-social players include "Killers," "Griefers," and bullies who find pleasure in frustrating other players or interfering with their experience. Pro-social players include "socializers" and those who enjoy "people fun." They find pleasure in cooperation, competition, and communication as well as developing or exercising meaningful relationships with other players.

Term 7 - Learning Game Player Types

Four player types of educational games are proposed, based on speed and accuracy of play. Achievers are problem solvers who play quickly and make few errors. They enjoy playing and winning are motivated by extrinsic achievement goals. Explorers play slowly and make few errors/problem solve but are more focused on their own curiosity and imagination than on the game requirements. They enjoy exploring ideas, role play and game mechanics more than earning top scores. Careless players play quickly and make many errors. They tend to be random-guesses interested in finishing quickly and enjoy playing but are not particularly motivated to learn. Lost players play slowly and make many errors. They are random guessers who tend not to enjoy either playing or learning from the game.

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