Immersed, but How? That Is the Question

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The success of any computer game, be it recreational or educational, is dependent on the engagement of the player during the first and subsequent interactions. A literature search on desired game characteristics results in varied opinions, but they all suggest that the success of a game is increased when the immersive characteristics of that game grab the attention of the player. They state that when immersion occurs, in the sense of losing track of time through the complete focus on the task at hand, the game motivates the player to repeatedly engage in play. This type of motivation has been described as flow. The concept of flow can be used to identify which computer games foster the persistent re-engagement of the player and eye-tracking technology can be utilized to verify player immersion. The analysis here, however, shows that unless the game also scaffolds the player's abilities, this immersion will be lost and the game will fail. The player's abilities are incremented in a recursive loop, illustrated in a model. The scaffolded level of skill requirement is what creates the immersion and the player's desire to engage. The research described in this article also presents a game flow evaluation matrix for analysing player immersion, prototyped on a newly developed commercial game, and validated against market perceptions of the same game upon release.

Keywords: action, computer games, eye-tracking, immersion, learning, usability

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Usability and playability evaluations have considerable face validity and provide useful data for the game development process. User testing is the benchmark of any playability evaluation, since a designer can never predict user behavior. Heuristics appear to be very useful for creating highly usable and playable game design. Although games cannot be compared directly to a standard software product, the Human-Computer Interaction (HCI) community offers a variety of approaches and techniques (Jørgensen 2004) that can be successfully implemented in different stages of the game design process, such as concept development, pre-production, production, and post-production (Sykes & Federoff 2006). The goal of player-centered game design approach is to increase player enjoyment and thereby directly influence the commercial success of the game. When we observe a player's behavior, we obtain the specific knowledge necessary to resolve any design problems. As a result, player immersion and challenge as well as increased player enjoyment are guaranteed.

Although player enjoyment is central to computer games, there is currently no accepted model of player enjoyment in games: "Player enjoyment is the single most important goal for computer games. If players do not enjoy the game, they will not play the game" (Sweetser & Wyeth 2005).

Persistent Re-engagement in Immersion

There are many heuristics in the literature, based on elements such as the game interface, mechanics, gameplay, and narrative. These have been integrated here into a validated model that can be used to design, evaluate, and understand enjoyment in games, as well as test the playability and instructional design of the game. From available and published research, we have drawn together the various heuristics into a concise model of enjoyment in games that is structured by flow. *Flow* is a widely accepted model of enjoyment and includes various elements that encompass the various heuristics from the literature. Czikszentmihalyi (1990, 71) suggests that a high level of flow is associated with an experience that is "so gratifying that people are willing to do it for its own sake, with little concern for what they will get out of it, even when it is difficult or dangerous".

Setzer & Duckett (1994) suggests that the characteristics of commercial computer games create an environment where players are compelled to play to the extent of forming addictions. Garris, Ahlers, and Driskell (2002) state that this addiction, or persistent re-engagement by the player, is what instructional designers strive to create, and de Castell and Jensen (2003) argue that many games are not successful because they fail to immerse the player. Kearney (2006) suggests that some games have rules where the consequences of failure are increased, and the goal of the game informs the player of the relevance of the gameplay. The following elements are included in various lists of essential game characteristics that add to immersion (Garris, Ahlers & Driskell 2002; Buchanan 2004; Kearney & Pivec 2007).

- Fantasy – Imaginary or fantasy context, themes, or characters
- Rules/Goals – Clear rules, goals, and feedback on progress towards the goals
- Sensory Stimuli – Dramatic or novel visual and auditory stimuli
- Challenge – Optimal level of activity and uncertain goal attainment
- Mystery – Optimal level of informational complexity
- Control – Active learner control

Quinn (1996) suggests that computer games can be highly effective when used in an educational environment. He also cites the concept of flow from Czikszentmihalyi (1990), in conjunction with Malone's (1981) critical elements of fantasy, challenge, and curiosity; both concepts are used and extended by Garris, Ahlers and Driskell (2002) for their model of Game-Based Learning (GBL). The concept of flow can also be used to identify which computer games foster the persistent re-engagement of the player and create player immersion, by analyzing computer games with a game-flow analysis model (Sweetser & Wyeth 2005).

Flow Analysis to Identify Immersive Characteristics

Sweetser and Wyeth (2005) adapted Czikszentmihalyi's (1990) theory of flow to identify player enjoyment of commercial computer games. Czikszentmihalyi (1990) suggests that flow consists of:

- a task that can be completed, has clearly identified goals, and provides immediate feedback,
- the ability to concentrate on the task and exercise a sense of control over one's actions, and
- an immersion that removes awareness of the frustrations of everyday life whereby the sense of the duration of time is altered.

Sweetser and Wyeth (2005, 4) mapped the above flow elements to elements from published literature on computer games (Table 1), to develop an evaluation model of player enjoyment in commercial games.

The Game Itself	Tasks that can be completed
Challenge and Player Skills	Tasks that can be completed
Concentration on the Game	The ability to concentrate on the task
Game Objectives	The task has clearly identified goals
Game Feedback	The task provides immediate feedback
Player Control	Sense of control over one's actions
Player Immersion	Removes awareness of everyday life
Player Immersion	The concern for one's self disappears
Player Immersion	The sense of the duration of time is altered
Social Interaction	(Not included in Flow)

Table 1. Identified Game Flow Elements (Sweetser & Wyeth 2005, 4).

An evaluation model was created and two commercial real-time strategy games were subsequently analysed by Sweetser and Wyeth. Although not conclusive, results showed that this model could be used to identify games that provide for player enjoyment.

A modification of the above described analysis matrix was utilised for the research reported in this article, in terms of an analysis of game genres of different types, including the design of educational games. In addition, an expert analysis (as in the case of Sweetser and Wyeth) was compared with a novice analysis. The results from this comparison suggest a difference between the expert and novice analyses, thereby requiring additional modification of the evaluation process. Features that the novice found motivational, helpful, or fun, the expert player did not. The expert player instead perceived these features as a "waste of time", uninteresting, and distracting.

While the eight categories from the original Sweetser and Wyeth table were maintained, our modified matrix consists of only four questions per category. Some of the questions were simplified to allow for more uniform answers and the scoring system was amended to provide a more meaningful result. The modifications were derived from interviews with both novice and expert players, and the developers themselves. The changes were the result of the matrix being used over a period of three semesters in nine tertiary classes on game studies (engaging approximately 120 students, aged 19 to 26). Computer games also create social environments where affective learning occurs (see figure 15), hence this was seen as an important inclusion in the matrix. The modified analysis matrix was then used successfully in a commercial environment to complete a usability test of a newly developed puzzle game. The testers found this modified flow evaluation matrix to be a highly valuable tool in the process of usability testing. This matrix is included below as Table 2.

Element Criteria	**Game Title Evaluated:**	**Score**
1.Concentration Games should require concentration and the player should be able to concentrate on the game	1.1 The game should quickly grab the player's attention	1.1 –
	1.2 The game should maintain the player's focus throughout the game	1.2 –
	1.3 The player should not be burdened with tasks that do not feel important	1.3 –
	1.4 The game should have a high workload, while still being appropriate for the player's perceptual, cognitive, and memory limits	1.4 –
	Average score	
2.Challenge Games should be sufficiently challenging and match the	2.1 The challenges in the game must match the player's skill level; games should provide different levels of challenge for different players	2.1 –

Cont'd.

Cont'd.

player's skill level	2.2 The level of challenge should increase as the player progresses through the game and increases his/her skill level	2.2 –
	2.3 The game should provide new challenges at an appropriate pace	2.3 –
	2.4 The game should provide multiple stimuli from different sources	2.4 –
	Average score	
3.Player Skills Games must support player skill development and mastery	3.1 The player should be able to start playing the game without reading a manual	3.1 –
	3.2 The game should include in-game help so players do not need to exit the game	3.2 –
	3.3 The player should be taught to play the game through game-like tutorials or initial levels of the game	3.3 –
	3.4 The player should be rewarded appropriately for his/her effort as his/her skill develops through the game	3.4 –
	Average score	
4.Control Players should experience a sense of control over their actions in the game	4.1 The player should experience a sense of control over his/her characters or units and their movements and interactions in the game world	4.1 –
	4.2 The player should experience a sense of control over the game interface and input devices	4.2 –
	4.3 The player should not be able to make mistakes that are detrimental to the game and should be supported in recovering from mistakes	4.3 –
	4.4 The player should experience a sense of control over the actions that he/she takes and the strategies that he/she uses and be free to play the game the way that he/she wants (not simply discover actions and strategies planned by the game developers)	4.4 –

Cont'd.

Cont'd.

	Average score	
5.Clear Goals Games should provide the player with clear goals at appropriate times	5.1 The overall goals of the game should be clear and presented early in the game	5.1 –
	5.2 Intermediate goals should be clear and presented at appropriate times	5.2 –
	5.3 Intermediate goals must add to the progress towards the overall goal of the game	5.3 –
	5.4 Help should be provided to the player if goals are not met	5.4 –
	Average score	
6.Feedback Players must receive appropriate feedback at appropriate times	6.1 The player should receive feedback on progress toward his/her goals	6.1 –
	6.2 The player should receive immediate feedback on his/her actions	6.2 –
	6.3 The player should always know his/her character's status, health, or score	6.3 –
	6.4 The presentation of feedback should be clear and unobtrusive	6.4 –
	Average score	
7.Immersion Players should experience deep but effortless involvement in the game	7.1 The player should become less aware of his/her surroundings while playing	7.1 –
	7.2 The player should become less self-aware and less worried about everyday life	7.2 –
	7.3 The player should experience an altered sense of time	7.3 –
	7.4 The player should feel emotionally involved in the game or committed to it through time and effort invested in the game	7.4 –
	Average score	
8.Social Interaction Games should	8.1 The game should support competition between players	8.1 –

Cont'd.

Cont'd.

support and create opportunities for social interaction	8.2 The game should support collaboration and cooperation between players	8.2 –
	8.3 The game should support social interaction between players (chat etc.)	8.3 –
	8.4 The game should support social communities inside and outside the game	8.4 –
	Average score	
	Overall Avereged Total	

Scores: 0 – N/A, 1 – not at all, 2 – below average, 3 – average, 4 – above average, 5 – well done

Table 2. Game Flow Evaluation Matrix.

Eye-Tracking to Identify Player Immersion

In an early study by the authors, it was suggested that eye tracking technology could also be utilized to identify player immersion (Kearney & Pivec 2006). Eye gaze, blink rate, scanning patterns and pupil diameter can be measured while playing, and these are indicators of mental processing (Kahneman & Beatty 1966; Rayner 1998). For this research, a Tobii ET-1750 eye-tracking monitor was employed to record the eye movements while playing selected commercial computer games of varying genres. The ET-1750 is a 17-inch TFT monitor that runs at a resolution of 1280 x 1024 and uses a pair of near infra-red light-emitting diodes (NIR-LEDs) and cameras for corneal reflection eye tracking. However, the recording software from Tobii utilizes DirectX technology, and this can cause a conflict with some commercial games that require exclusive control of the installed graphics card. Modifications were required in some cases to the procedure of capturing data in a 3D full screen environment.

The applications included were of different genres and varying design, and both the gaze plot and hotspot data were analyzed. The gaze plot displays a static view of the gaze data for each image of the stimuli and is a useful tool when visualizing scan paths. Each fixation is illustrated with a semi-transparent dot where the radius represents the length of the fixation. Hotspot data consist of the stimuli as background image and a hotspot mask superimposed on top of this. The hotspot mask consists of a black background, which is highlighted around points where test persons have been looking. The games tested with the eye tracker were:

- *Counter-Strike* – 3D first person shooter (FPS) simulator
- *Quake II* – 3D first person shooter fantasy
- *Tomb Raider* – 3D third person adventure
- *Neverwinter Nights* – isometric fantasy role play
- *Abuse* – 2D side scrolling shooter fantasy
- *Tetris* – 2D full screen and windowed puzzle game with keyboard control
- *Chess* – 2D and 3D full screen puzzle game
- *Solitaire* – 2D windowed puzzle game with mouse control
- *Game X* – an alpha version of a commercial puzzle game

As with similar studies by Kenny *et al.* (2005) and Sennersten (2004), in a first-person shooter game such as *Counter-Strike* (figures 1 and 2) and *Quake*, the player's eyes spend the majority of the time focused on the centre of the screen.

Figure 1. Eye-Tracker gaze plot from Counter-Strike.

Figure 2. Eye-Tracker hotspot analysis from Counter-Strike.

This correlates with the movement of the mouse, as it is the mouse that moves the viewpoint. Also, the hand-eye co-ordinations of the mouse resulted in the mouse following closely behind the eye movement, and synchronization occurred when targeting for shooting. Similar findings resulted from testing the game *Tomb Raider* (figures 3 and 4).

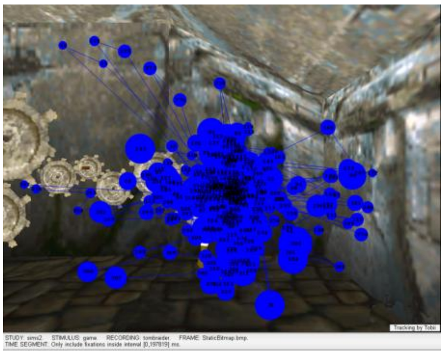

Figure 3. Eye-Tracker gaze plot from Tomb Raider.

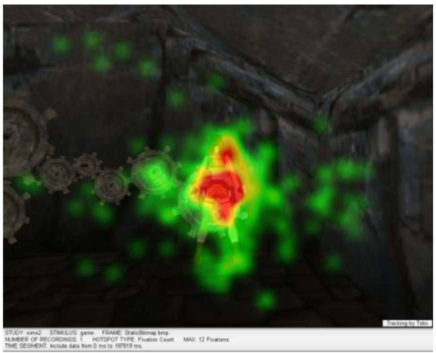

Figure 4. Eye-Tracker hotspot analysis from Tomb Raider.

The gaze plots shown from each of the 3D first and third person games display gaze points, fixations and scan-paths superimposed over a single screenshot of the game. The screenshot in both games is representative of the on-screen spatial layout of the games. However, it is not pertinent to the analysis of the eye-tracking data. The data were collected while playing a level for a 10-minute period and was repeated 5 times with each analysis providing results similar to those shown here. The hotspot analyses show that the player's eyes are fixed within the centre of the screen for the majority of the time in accordance with the interface design of an FPS game (Kearney & Pivec 2006).

This was not the case with the two-dimensional puzzle games *Solitaire* and *Tetris.* Results showed that eye movement here was more rapid, and traversed the entire field of play (shown in figures 5 and 6), while the mouse remained static. When the mouse was required to move an object in the case of *Solitaire*, this hand-eye co-ordination was performed using peripheral vision only.

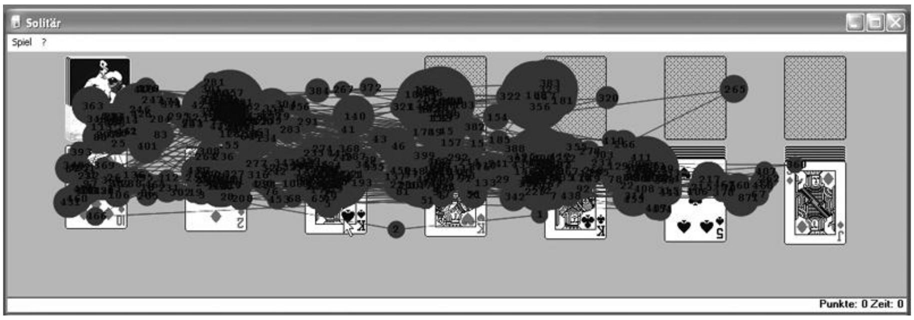

Figure 5. Eye-Tracker gaze plot from Solitaire.

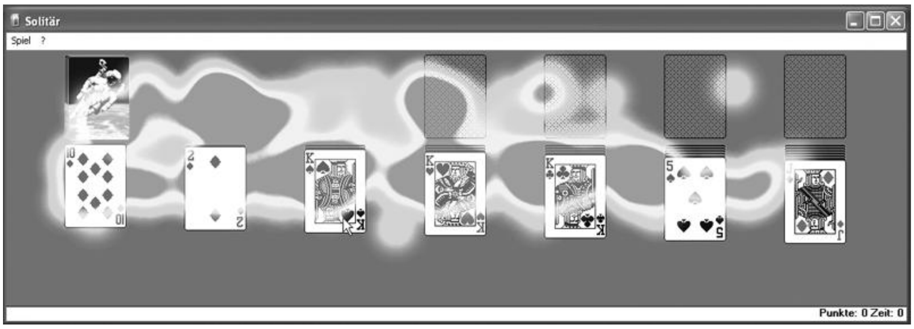

Figure 6. Eye-Tracker hotspot analysis from Solitaire.

With the falling block game *Tetris* (figures 7 and 8), eye movement was focused on the object being manipulated for much of the time, but also traversed the screen frequently. The object was moved with the keyboard and the eyes remained synchronized with this movement for short periods of time only.

The isometric viewpoint of *Neverwinter Nights* (figures 9 and 10) resulted in dispersed eye patterns, with the eye gaze focused on the area of activity. This varied depending on what was happening in the game at the time, character communication, character movement, etc.

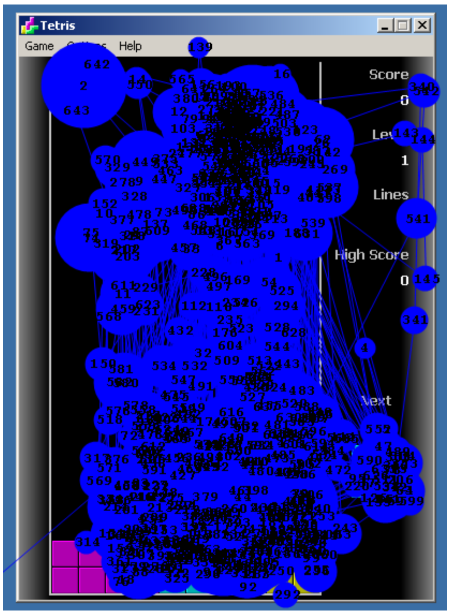

Figure 7. Eye-Tracker gaze plot from Tetris.

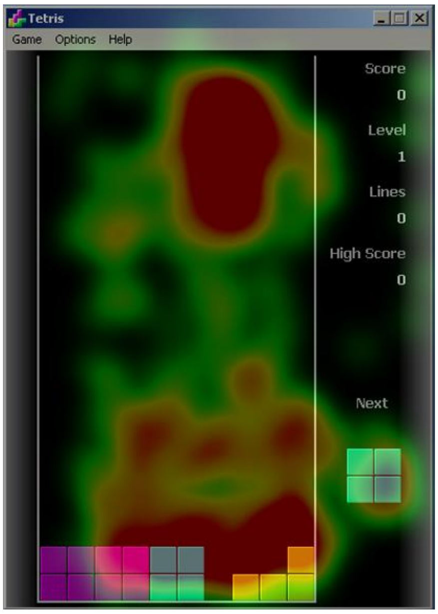

Figure 8. Eye-Tracker hotspot analysis from Tetris.

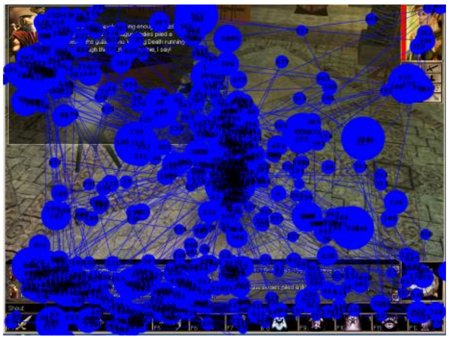

Figure 9. Eye-Tracker gaze plot from Neverwinter Nights.

Figure 10. Eye-Tracker hotspot analysis from Neverwinter Nights.

In the game *Abuse* (figures 11 and 12), although a two-dimensional side scrolling platform, most of the activity focused within the centre of the screen dispersing outwards. The player's character was restricted in movement by automatically scrolling the background, keeping the character close to the centre of the screen. Similar to today's 3D first person shooter games, thus, the 2D game *Abuse* pioneered the use of the keyboard and the mouse in game play, allowing movement through use of the keyboard and targeting/firing via the mouse.

This game also includes a tutorial within the first level of play. The game levels are linear and the level of difficulty is progressively increased, allowing the player to progress through the game as player ability was improved and goals were achieved. Using the game flow evaluation matrix, *Abuse* scored a credible 4.5 out of 5, and in reality was one of the most successful games of its time.

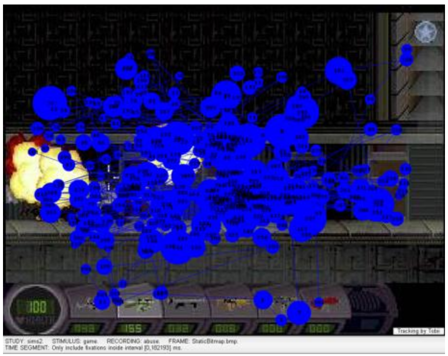

Figure 11. Eye-Tracker gaze plot from Abuse.

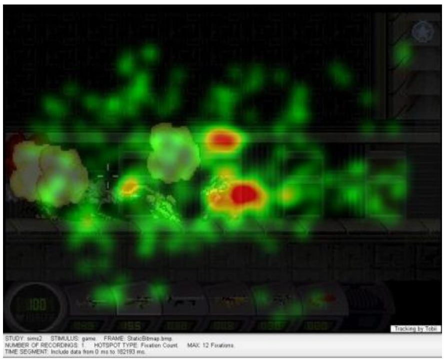

Figure 12. Eye-Tracker hotspot analysis from Abuse.

It could be argued that the inherent design of the game will dictate the eye movement required, but immersive games reduce the player's eye movement and blink rate, which can therefore indicate player immersion (Kearney & Pivec 2006; Kahneman & Beatty 1966; Rayner 1998). Research also suggests that the less eye movement on a screen, the greater the absorption of the information. Zambarbieri (2005, 1) suggests that "if your eyes jump around on your computer screen, it's usually because you are struggling to absorb what you see and read". Screen layouts that reduce eye movement allow for a more in-depth absorption of data. The player's concentration is increased and this is evident in the immersive environments created by some commercial games.

Concentration is one of the elements identified in the game flow evaluation matrix. However, challenge, feedback, and player skill are also essential components to ensure player immersion and encourage persistent re-engagement and subsequently also the success of the game. The persistent re-engagement is obtained by appropriate scaffolding of the challenges presented to the player. Scaffolding can occur when the level of cognitive challenge is appropriate for the player's current abilities. If it is presented at the wrong level, i.e. too difficult or too easy, learning will not occur, and even in a recreational computer game such as *Counter-Strike* or *Tomb Raider*, learning must occur to allow the player to advance through the game. We call this *recursive* learning (Kearney & Pivec 2007).

Immersed in Recursive Loops of Game-Based Learning

Recursive learning is a term usually applied to algorithms used in computer programming. The term recursive loop is used to denote when a task is performed repeatedly until a counter of some kind has been incremented, and the task then ends or is modified. We can apply the same methodology to game-based learning and suggest that the player will repeat the level or task until the learning outcome or goal has been achieved. The player's ability is then incremented and the game moves to the next level.

Garris, Ahlers, and Driskell (2002) also suggest that the learning outcomes occur outside of the game during reflection and debriefing (figure 13).

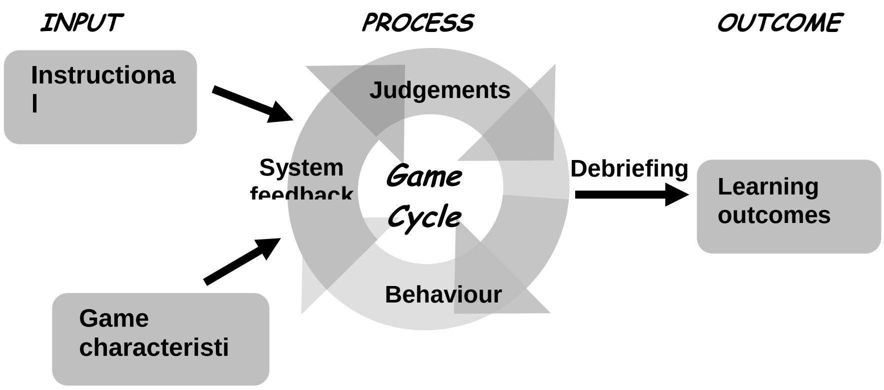

Figure 13. Learning in GBL (Garris, Ahlers & Driskell 2002, 445).

This may be true for declarative knowledge, but to succeed in the fast paced action games available today, players must increase their procedural and strategic knowledge within the game itself. Shaffer (2006) calls this reflection-in-action, as opposed to reflection-on-action which would correspond to the debriefing in figure 13. Shaffer suggests that the virtual worlds created by such games allow students to take action within the game and then reflect on this action, both during and after play.

Kolb (1984), on the other hand, suggests that learning follows a cyclic pattern, and that reflection on experience is part of the learning cycle itself (figure 14).

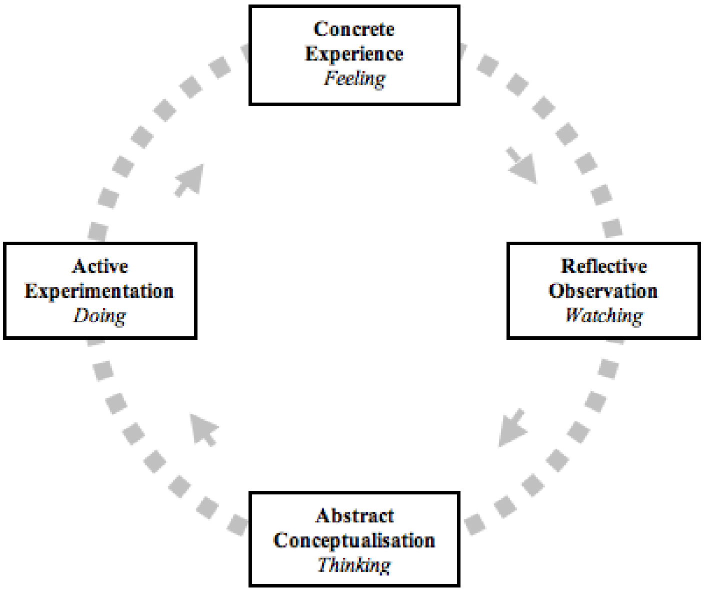

Figure 14. Kolb's learning styles (Kolb 1984, 35).

In this sense, Kolb's model of learning styles is reminiscent of Shaffer's reflection-in-action. Similarly, Paras & Bizzocchi (2005) state that when play is separated from reflection, the learning is reduced, but if reflection is dispersed within the game itself, the learner/player takes responsibility for the learning outcomes.

Reflection can occur during periods between the levels of the game, or while waiting for the game to complete a simulation, or even be part of the game itself. For example, Kearney (2005) compared the commercial game *Counter-Strike* with *Quake III*, both first-person shooter multi-player computer games. In the game *Counter-Strike*, if players are shot, they are required to wait between missions until the remainder of their team wins or loses the level. This provides time to reflect on game strategy, decisions, and subsequent actions, while they are passive observers of the game being played. In *Quake III*, players can re-enter the game immediately and no time for reflection is provided. The results of Kearney's study showed that players of the game *Counter-Strike* improved their multi-tasking ability by up to 2.5 times more than that of *Quake III* players; the time used for reflecting before re-entering the game may have contributed to this improvement.

Knowledge based skills are defined as declarative, procedural, strategic knowledge. Declarative knowledge are the facts and data that are required to complete a task or to perform well within the task. These should be provided directly from the game or from some type of player feedback. Procedural knowledge is required to know how to approach a task and subsequently complete it. This could be referred to as knowing how to apply the declarative knowledge to a given situation. Strategic knowledge is the reasoning behind the task and how the task could be achieved in a different or more creative way. Each of these skills is achieved through reflection, but with many fast action computer games, this occurs as reflection-in-action throughout the game cycle and within each level. This is the macro cycle. As skills and abilities are attained, the player advances through the game and increments his/her knowledge.

We further suggest that, depending on a player's ability or experience, the learning will occur only if the player enters the game at the appropriate level as shown in figure 15. Vygotsky (1978, 86) suggested that "the distance between the actual developmental level as determined by independent problem solving and the level of potential development as determined through problem solving" is where the learning occurs. However, he suggests that this is facilitated through peer collaboration or teacher involvement, but the computer game itself can act as the teacher.

With multiplayer games, peer collaboration occurs between players and has been observed to foster learning (Kasvi 2000).

We propose an expansion on the model from Garris, Ahlers, and Driskell (2002) to include a time dimension. This dimension allows us to follow the game play and the progression throughout the game. Within the model we can observe the macro and micro game cycles (figure 15) and include player reflection within the game, during play, and between levels, and suggest where the different types of learning occur; skill based, knowledge based, and affective.

Commercial computer games are known for creating social environments and cult followings surrounding the gameplay, the character attributes, and players' abilities, and we suggest this is where affective learning occurs. Garris, Ahlers, and Driskell (2002, 457) describe affective learning as including "feelings of confidence, self-efficacy, attitudes, preferences, and dispositions". The skill-based learning appears to comfortably fit within the micro game cycle or levels within the game. For example, Rosser *et al.* (2007), found that the playing of commercial action games improved the surgical skills of laparoscopic physicians and decreased their error rate. There was no documented debriefing session for Rosser's *et al.* study and it is assumed that the development of technical or motor skills occur within the game itself.

Figure 15 also shows how player ability and experience affect the challenge element and the level of learning (Zone of Proximal Development, Vygotsky 1978), and how the level of cognitive challenge can be appropriate for the learner's current abilities. The model also shows the inclusion of instructional design and game characteristics as critical elements of a game to enable the achievement of the learning outcomes, as well as the additional factor of player abilities. Game-Based Learning occurs in a recursive loop and as such, when the player skills are acquired, or incremented, the player moves on to the next level of the game. This is true for both educational and commercial recreational games. The scaffolded level of skill requirement is what creates the immersion and the desire to play the game.

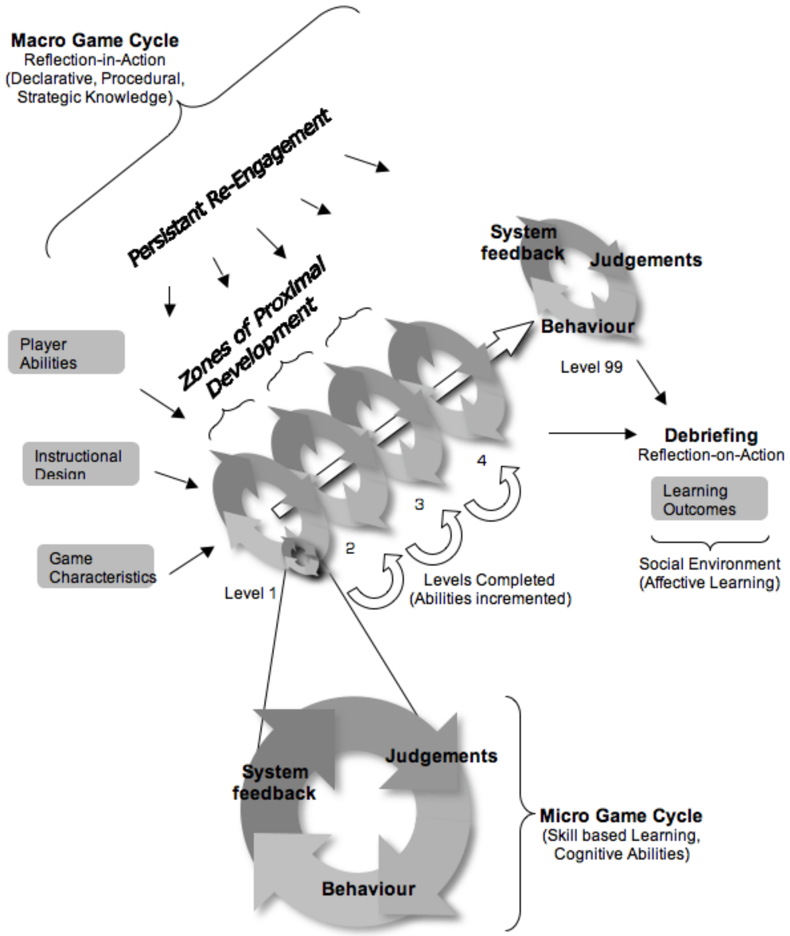

Figure 15. Recursive loops of Game-Based Learning (Kearney & Pivec 2007, 2551).

Essential Game Characteristics for Immersion

Both the game flow evaluation matrix and the eye-tracking analysis were used successfully in a usability test of a pre-released commercial puzzle game (due to commercial sensitivity and contractual obligations, this game is referred to as *Game X* and screen shots cannot be included in this paper). The game is played in a 3D virtual world with a third person point of view. Think of the game as *Tomb Raider* meets *Tetris*. Hence the player viewpoint and subsequent eye-tracking results were similar to those of *Counter-Strike*, suggesting an immersive game. *Game X* also scored above average for the immersion category in the evaluation matrix, but the overall averaged total was only 2.1 out of 5 – presenting a concern for developer and publisher both. Only one participant of the usability test group suggested that they would buy the game if it were priced accordingly.

Game X scored high in player control but low in the feedback category. However, the major concern was related to the player's ability to progress through the game. The developer had deliberately avoided a linear design to give the player more options and freedom to play some levels without completing pre-requisite levels. Similar games of this type had received bad press for players' inability to move forward within the game while being trapped on a particularly difficult level. Although the idea was sound, it unfortunately resulted in confusion and frustration of the player. Subsequent press reviews of the released game stated: "I think the game kind of fell short of where it could have been. The idea is totally sound, but the end product clearly wasn't what the developers were trying to do."[1]

Some levels were inconsistent in their scaffolding of difficulty. The level of difficulty must be increased in a linear fashion to scaffold the level of mastery and therefore enjoyment of the player. If the frustration is too high and the learning curve is too steep, the player will quickly lose interest: "The levels take anywhere from 10 seconds to 10 minutes to complete, and you'll see many recurring designs throughout the game's 100+ levels, this can get more than a little repetitive."

The developers were advised to sequence the levels of play and only unlock particularly difficult levels after a player's ability counter had been incremented. This could be time based or goal based. However, the player frustration also pointed to tutorial improvement and the necessity of guided play in early levels. Reviewers subsequently stated: "the levels are grouped into zones, with three zones for each of the three difficulty levels. Aside from the color of the items and the background, there's very little difference from zone to zone, which saps any sense of accomplishment or progression you might have derived from playing".

As was the case with *Game X*, the game development team should not design tutorials for their own game, especially if no knowledge of scaffolding mastery is present. They should also not rely on their own usability testing. A game will succeed or fail on reviewer's comments and scoring. Gamer forums and players' word of mouth are also powerful factors that affect how well a product will penetrate the market. An analysis of reviews and forum comments highlight the fact that it is not usually what is good about a game, but what is bad about a game that destroys it (Pivec Labs 2009).

Conclusion

We asked the question *"Immersed, but how?"* because most of the literature stated that learning is increased if the player is completely focused on the task, i.e.: immersed. Successful games create player immersion and thereby encourage the persistent re-engagement of the player. Repeated engagement with the game not only results in drill and practice, but also reinforces the lessons learnt and enables the player to experiment and learn from mistakes in a safe virtual environment. We used eye-tracking technology in an attempt to identify player immersion and further developed the game flow evaluation matrix to identify commercial games with immersive qualities. We found that eye-tracking techniques alone cannot be used to identify player immersion because of the varying screen designs and game types. However, eye-tracking can be used during the design phase to create an interface that minimizes eye movement and increases the potential concentration at the same time.

The game flow evaluation matrix does identify essential game characteristics that are paramount if a computer game is to be successful. We validated this with a newly developed commercial game and saw the results. We are continuing to use this methodology in a commercial environment to ascertain the success factor of new games while in the development phase (Pivec Labs 2009). Player control and immersion are vital elements for the success of a game, as is the scaffolding of player abilities. The recursive loops of the GBL model (Kearney & Pivec 2007) are useful for the analysis of educational games, and can also be successfully applied as a design and evaluation aid to recreational computer games. The player's abilities in relation to such games must be learnt and subsequently incremented, for the player to successfully progress through the game and enjoy the gameplay. We call this "Gamability".

In conclusion, clearly outlined goals of a game create the challenge necessary to evoke player immersion. The persistent re-engagement of the player dictates the success of the game and is dependent on the game's ability to maintain immersion by staying within the upper zone of the player's ability, as well as providing the essential characteristics of flow within the game.[2]

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Notes

1. The press quotes cited herein are anonymised due to commercial sensitivity.
2. For more information on this evaluation methodology, visit <http://www.piveclabs.com>.

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