Problematizing Learning Interactions vis-à-vis Game Interactions

By ONG Choon Cheng, Cindy

This paper discusses learning interactions in the context of digital games, drawing specific examples from Restaurant City and Maple Story. It advocates the need to rethink the design of learning interactions by illustrating the complexity of the learning process and how educational practitioners can actively mediate the learning experience through redesign of learning environment, teacher and student roles. It also touches on the 'game-ification' of learning and implications of this phenomenon on formal education.

Clarifying the Definition of "Interaction"

Interaction is defined by the *Oxford Dictionary Online* to mean reciprocal action, "action or influence of persons or things on each other". While this definition does help one understand the meaning of the word, it does not explain interaction as a concept. Conceptually, interaction connotes different meanings when used in different fields. For instance, in statistics, the term 'interaction' is used when the outcome of multiple variables is not additive; while in physics, the same term refers to a transfer of energy.[1] There thus lies a need to clarify how interaction is used and what it is taken to mean in this paper.

In this paper, interaction is defined as a process involving action, response to action, i.e. reaction and further action. This definition takes reference from Greeno (2006), which positioned interaction as a process of collaboration and negotiation that makes (group) thinking visible. This consideration is also similar to what Gee (2007) alluded to when he discussed interaction in the context of games, that games do "talk back". He asserted, "nothing happens until a player acts and makes decisions. Then the game reacts back, giving the player feedback and new problems."

Interactions in Gaming Contexts

Hoffman (2009) noted that research in recent years has surfaced positive effects of games with regard to learning by "stimulating their imaginations, sparking their curiosity, and promoting the exploration of difficult issues and concepts." These positive effects arose from the interaction between the game and players as well as among players (in multi-player games), creating an impetus to study interactions in gaming contexts, in a bid to duplicate such success in formal learning contexts. Understanding how games incorporate good learning principles can potentially inform learning design and possibly guide the transformation of formal education.

Game interactions in general are realized through rules, which Schell (2008) propounded as the most fundamental of game mechanics. According to Schell, rules "define the space, the objects, the actions, the consequences of the actions, the constraints on the actions, and the goals". Typically, rules in games pertain to reward systems and time schedules. For example, SCNVGR (2010) identified seven types of reward schedules game designers can incorporate in games to steer player behavior.

[1] Please refer to Google Dictionary for a more comprehensive list of the different meanings for 'interaction'.

Reward schedules comprise contingency, response and reinforcer and are the mechanism through which rewards are delivered. While SCNVGR (2010) listed these seven types of reward schedules as discrete items, they can be organized into three broad categories as shown in Diagram 1 below. Interval schedules correlate time or timeliness and behavior or action, while ratio schedules correlate reinforcement and action.

Diagram 1: SCNVGR's List of Game Mechanics – Reward Schedules

1. **Interval based reward schedules** provide a reward after a certain amount of time. There are two flavors: variable and fixed.	2. **Ratio schedules** provide a reward after a number of actions. There are two flavors: variable and fixed.
• **Variable interval reward schedules** provide a reward after a roughly consistent amount of time. This tends to create a reasonably high level of activity over time, as the player could receive a reward at any time but never the burst as created under a fixed schedule. This system is also more immune to the nadir right after the receiving of a reward, but also lacks the zenith of activity before a reward is unlocked due to high levels of ambiguity.	• A **variable ratio reward schedule** provides rewards after a roughly consistent but unknown amount of actions. This creates a relatively high consistent rate of activity (as there could always be a reward after the next action) with a slight increase as the expected reward threshold is reached, but never the huge burst of a fixed ratio schedule. It's also more immune to nadirs in engagement after a reward is achieved.
• **Fixed Interval Reward Schedules** provide a reward after a fixed amount of time, say 30 minutes. This tends to create a low engagement after a reward, and then gradually increasing activity until a reward is given, followed by another lull in engagement.	• A **fixed ratio reward schedule** provides rewards after a fixed number of actions. This creates cyclical nadirs of engagement (because the first action will not create any reward so incentive is low) and then bursts of activity as the reward gets closer and closer.
3. Chain Schedules – The practice of linking a reward to a series of contingencies. Players tend to treat these as simply the individual contingencies. Unlocking one step in the contingency is often viewed as an individual reward by the player.	

These correlations are not new and have been extensively researched upon by behaviorist learning theorists. However, a pertinent observation regarding the use of reward schedules in games is the positioning of these schedules within a larger reward system. Games typically consist of a variety of reward schedules, depending on the task at hand and other circumstantial factors e.g. training task, e.g. ad-hoc killing of monsters or bosses or performance task, e.g. raid that are time-bound or location-bound. Such variety keeps the player on his or her toes, building anticipation and excitement as the player is never quite certain what will result from his or her action.

In the scheme of rewards and reinforcements, Reeves (2009) discussed the positioning of feedback in games by users. Reeves (2009: 72) argued that in gaming contexts, players actively desire feedback, both positive and negative, so as to advance more quickly towards their goal(s). In learning contexts however, feedback is often considered to be the teacher or an expert telling the learner or a novice what they are doing well and what needs further improvement. Little regard is placed on changing

behavior as opposed to sharing information. Furthermore, it does not consider where the individual or group receiving feedback desires the feedback or not. Simply put, games are designed that feedback is not only necessary but also desirable, a premium status that feedback has yet to occupy in formal education.

One of the guiding principles in game design is behavioral contrast, where changing expectations can lead to a change in behavior, which is realized through reward schedules as well as other game rules such as disincentives[2], extinction[3] and avoidance[4]. Collectively, these mechanics aid players in 'learning the game' and reach their desired goals.

In summary, games place at the center of their design the player experience, which is determined by how the player interacts with game elements and other players. This is realized through a constant and timely feedback mechanism in the form of reward systems, supported by related mechanics of disincentives, extinction and avoidance. Given the success of games, indicated by growing number of gamers across the world, it would be useful for education practitioners to understand how games engage its players and support them in learning the game. These lessons drawn from games can hopefully inform learning design and lead to higher student engagement and better learning outcomes.

Realizing Learning Theories through Game Interactions

This section examines game mechanics in relation to learning theories, drawing examples for behaviorist, cognitivist, constructivist and social learning theories. It attempts to explain how game mechanics effectively apply these theories two broad areas, focusing primarily on (1) input: structuring of the game space, specifically in terms of information provision and touching on (2) output: encouraging desired behavior.

The cognitive theory of multimedia learning presented by Mayer (1998) put forth the notion that multiple modes of representation presented simultaneously aids learning. He also advocated for the removal of extraneous information in multimedia explanation or presentation as it can impede learning. Mayer's theory is built on the assumption that humans have two channels for taking in and processing information – audio and visual, presupposing also that each channel has limited processing capacity.

This theory mirrors the cascading information theory game designers apply to games, where "information should be released in the minimum snippets to gain the appropriate level of understanding at each point during a game narrative" (SCNVGR, 2010). In games, players are provided with information "just-in-time" and "on demand" (Gee: 2007). For example, in multi-media online role-playing games (MMORPG) such as World of Warcraft and Maple Story, players are only provided with enough information within the game world to proceed to the next level. They are not explicitly informed how many levels there are within the game (which usually can be expanded with game updates). This helps players gauge their performance with reference to their immediate goal as well as directing their attention to an attainable short-term focal point – moving up to the next level. The same principles apply to in-game activities such as raids and killing of mobs or bosses.

[2] Disincentive uses penalty to induce behavioral shift.
[3] Extinction refers to the stopping of a reward.
[4] Avoidance is an act of inducing player behavior through an absence of feedback, i.e. no reward and no punishment.

It is pertinent at this point to briefly and generically describe the richness of information embedded within any game environment, whether they are mini-games (and consequently less time investment required) such as Restaurant City or MMORP games such as Maple Story that require extended time investment.

Diagram 2: Screen Capture of Restaurant City[5]

Presented at the top of this Restaurant City game screen are four different types of feedback for players: (1) game currency called "coins", (2) game credits purchased with cash called "cooking cash", (3) game level and distance from the next level[6] and (4) restaurant popularity. All these different types of feedback focus on communicating to the player pertinent information that will help them move from where they are presently to the next level.

[5] In Restaurant City, every player manages his or her restaurant and proceeds to the next level by learning and serving new dishes, which require the accumulation of coins and/or cooking cash to buy ingredients required for learning new dishes.

[6] In this instance, because this particular player has reached maximum level, the game status bar does not reflect how far or near the player is from moving to the next level.

For a non-gamer, perhaps what would be most striking about the game screen is the absence of textual information. Information instead is communicated graphically in the form of icons that players *learn* to identify with and use when navigating within the game. Yet, there remains a wealth of information embedded within the game screen. The bottom of the main game screen contains nine icons that communicate a variety of information to the player. Information communicated (from left to right) included (1) operating hours of the restaurant, i.e. the number of hours that the restaurant will continue to accumulate coins and points (for leveling up), (2) main street where player can visit restaurants owned by friends, (3) restaurant interior decoration module, (4) employee management module, (5) menu management module, (6) latest collectible challenge, (7) past collectibles menu, (8) inbox and (9) game challenges.

Adhering to the principle of providing information "just-in-time" and "on demand", players are never forced to encounter or engage with extraneous information. Instead they are free to explore the game at their own pace, motivated by their personal gaming goals. This follows the constructivist theory of discovery learning that Brunner (1976) advocated, where learning takes place in the context of exploration and experimentation. The learner, in this instance the player, interacts with elements such as the above-mentioned icons in the game space and find out what these elements represent and the functions invested in these symbols. As they proceed, they construct an evolving model of the game, which shifts with every progression (in level).

To ensure that players continue the game, much effort has been made to ensure player engagement. Firstly, game challenges are often ordered from simple to difficult, where simple tasks prepare players for the more difficult ones ahead (Gee, 2007). In Maple Story for example, this sequencing is realized through different levels of monsters, which spawned in different locations within the game environment. Players can easily locate the information on the appropriate places to train, i.e. kill monsters and earn points for leveling up, and the monsters to kill that will help them move fastest to the next level on game forums. This information and other information pertinent to in-game progression is usually highlighted in these game forms in the form of a "sticky", where they remain constantly at the top of the message board.

The cycle of challenge and consolidation through well-ordered problems echoed the concept of zone of proximal development (ZPD) that Vygotsky (1978: 86) theorized. According to Vygotsky, ZPD refers to "the distance between the actual development level as determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance or in collaboration with more capable peers." Returning to Maple Story as an example, players start their game on a training island where they learn to fight and kill monsters practicing basic keyboard controls. They are sent on system-generated quests designed to help them learn (1) how to control their character avatar, (2) how to navigate and move within the game world, and (3) the reward system. A lesson learnt early in this game is that the more monsters you kill, the more points you accumulate and the faster you move to the next level. However, if the player is constantly killing low level monsters, the pace of progression will be slowed. Players thus learn very quickly that they need to know the highest level monster(s) they can challenge and kill at the game level that they are presently at, and what aids they can use e.g. armor and/or weapon that can help them kill a monster that is beyond their current abilities or power.

The brief illustration demonstrates the "pleasantly frustrating" nature of games, a term coined by Gee (2007). As the player progresses through game levels, each level marks the beginning of a new learning

process – what can they do with enhanced abilities and/or capabilities that come with a higher level, what monsters should they kill to maximize point gain and help them move to the next level within the shortest period of time? Very often, players know what is required of them but are unsure how to go about achieving their goals. To help them attain their goals, they turn to game guides, game forums, in-game chat and guilds to help them locate the required information, which testifies to the social nature of MMORPG. United by a common learning goal – to master the game, unknowingly, players of MMORPG such as Maple Story and War of Warcraft have created communities of practice (Lave & Wenger: 1998) through game forums and dedicated fan sites where players share experiences and information that would help each other grow in their mastery of the game.

To motivate players and sustain their interest in the game, most games have elaborate reward systems (as mentioned in previous section) to steer player behavior. In fact, game reward schedules often mirror classical conditioning theoretical principles e.g. extinction and delay etc. expounded upon by Pavlov (1927). Skinner (1950), like Pavlov, also focused on the physical manifestation of learning articulated a similar stimulus-response-reinforcement learning model, where reinforcement is "pleasant, satisfying, tension reducing, and so on". Returning to an earlier example, Restaurant City harnesses appointment dynamics to condition players to log into the game daily at particular hours; it releases new ingredients, challenges and quizzes daily at 5:00 pm pacific time. These quizzes and challenges have a validity period and expire after certain hours or days. Players who do not check into the game in time to activate these quizzes and challenges lose the rewards they might otherwise have earned.

In summary, what should be striking from the brief discussion above would be the inherent richness and complexity game and game environments present to players. The purpose of demonstrating how learning theories are effectively realized through games paved the way for a deeper discussion on what educational practitioners can learn from games and apply these lessons to formal education settings.

Lessons from Games, Informing Educational Practice

1. Redefining students as complex individuals

Teachers in planning or delivering lessons tend to conceptualize the students they teach as being 'learners only'. Even though research has proven that students are not empty receptacles to be filled and that they come with learning needs as well as skills and knowledge acquired beyond of the confines of the classroom, there remains a tendency to consider students primarily in cognitive terms. In recent years, research in learning motivations has begun to touch on the affective and social aspects of learning (Malone & Lepper, 1987). However there has yet to be an effective way to translate research into practice. Within the eco-system at school, students are individuals with personal beliefs and self-esteem participating both socio-culturally and organizationally. Students are part of social networks formed within the classroom and the larger school compound, as well as beyond the school compound. They have to submit to school rules and expectations and learn to 'do school' in accordance to how they wish to be perceived or positioned (Pope, 2003).

In brief, students have much more complex identities than being mere learners. The next question to ask would be – what does this realization mean for the teacher? When we begin to recognize the complexities that students deal with on a day-to-day basis, it calls for respect for students as equal individuals in the learning environment. This means that teachers should not consider students as lesser beings simply because they have yet to acquire particular skills or knowledge, but to recognize that

students do possess valuable skills and knowledge as they come. At this point, it is necessary to clarify that to respect students as equal individuals differs from considering teachers and students as peers or equals because teachers have been invested with organizational authority by the school to guide the students, and are thus role models and figures of authority.

There is thus a need to afford students' greater autonomy in their learning, which can be realized through the illusion of control. Games achieve this by embedding a large amount of information within the game world that players can explore and access when they need and/or desire to do so. However, while it appears as if the player is in control of the game, there remain subject to the rules of the game, i.e. kill 'x' amount of monsters to gain 'y' amount of points in order to progress to the next level. Even thought there is usually more than one way to level up, there are finite paths the players can take. Translated into formal education, there is a need to re-conceptualize the learning environment to afford for greater autonomy to explore on the part of the student within the confines of pre-determined curriculum standards and outcomes. Some new questions to ask include the following.

1. What skills or content knowledge do we want our students to learn?
2. How does this cognitive demand fit in with other aspects of a student's life – affectively, socially and organizationally?
3. What skills and knowledge that students already possess that can help them attain the learning goal?
4. What resources do students have that they can call upon (within and beyond school) to support their learning this particular skill or knowledge?
5. What materials can we put before them that would guide them to attaining the learning goal?
6. How many different ways can the learner approach or practice the skills or content knowledge?
7. How can students be empowered to support each other in their learning process?

Realistically, there is no perfect solution to student engagement. These questions will hopefully offer teachers a starting point to recognizing and tapping into the complex identities that students bring to the classroom. Furthermore, it is not possible for teachers to possess answers to all questions; there will be times where dialoguing and consulting students on how they want to learn what they have to learn can lead to fruitful results.

2. Re-conceptualizing classrooms as learning networks

Greeno (2006:79-80) offered, as a unit of analysis for learning sciences, activity systems that he defined as "complex social organizations containing learners, teachers, curriculum materials, software tools, and physical environment." He argued that focusing on the characteristics of activity systems when designing learning environments could direct participation in ways that encourage learning. More than a helpful unit of analysis, it is also valuable as a tool for designing learning experience, guiding teachers to expand the usual definition of learning environment as discrete entities e.g. in the classroom and at home etc to adopt a more holistic and systemic view of what constitutes learning environment. Missing in the current conceptualizing of learning environments, particularly in classrooms, is the recognition of the interconnectedness of all elements pertaining to learning e.g. physical, digital & social space, learners, teachers, media personalities, academia, school administrators and parents etc. and their collective power to influence learning outcomes.

In this aspect, game designers have effected a richly networked environment for players to navigate. In Maple Story for instance, players have dedicated islands for beginners' training and the game

environment organized into sub-worlds for players at different levels. Players are free to cross over at any time though they might not necessarily perform well in an environment designed to engage a player at a higher level. Laterally, individual quests, group quests, guilds etc. are also elements in the games that empower the player to develop a deeper understanding of the game (the object of learning). Beyond the game world, players have access to formal and informal game forums, as well as fan sites where they can share information and learn from each other how to better their game play. It is interesting to note that while a player at Level 100 might not be interested in interacting with a player at Level 10, s/he would be willing to share and dialogue with a player at Level 90, realizing what Lave (1998) described as communities of practice and legitimate peripheral participation.

Transposed into formal education, what perhaps is needed is a reconstruction of what constitutes the learning environment during curriculum and lesson design, considering how the 'real' and 'reel' world can be drawn into the classroom as part of the learning environment. For a start, it would be useful for teachers to consider the following.

1. How can I expand the classroom to include other spaces within the school? (Can that possibly extend the allotted curriculum hours?)
2. How can I harness other social and personal spaces that students participate in to continue the learning process?
3. Other than the teacher, who else can be involved in the learning process? (Would this lend authenticity to learning?)
4. How would the inclusion of all these spaces beyond the physical classroom impact lesson delivery and student engagement or response?
5. How is the learner positioned differently in different environments? Does this mean that there is a need to represent and communicate the same content differently?

Simply put, students are active participants in the world they live in, growing up as digital natives. They are used to navigating and learning in content- or media-rich worlds epitomized by games. To continue to confine learning of formal educational content in the physical space risks the dis-engagement of students. However, there is also a need to be mindful not to over-simplify this endeavor to consider the extremes e.g. classroom and social networks etc. It calls not for the inclusion of polarized worlds in learning but to consider the learning environment as a series of networked 'worlds'.

3. Rethinking the roles of teachers as learning designers and facilitators

Based on the proposed reframing presented in the earlier paragraphs, the roles teachers play in the learning process also call for rethinking. To begin with, it is no longer sufficient for teachers to see themselves as learning facilitators. They need to reposition themselves as designers of learning experiences, pulling together all available resources to students learn, asking the questions posed above. Beyond that they also serve as gatekeepers to ensure learning is meaningful to students – where students understand the purpose of learning what they are learning.

At this point, it is pertinent to clarify that while there is much to be learnt from how games regarding learning interactions and there are benefits to be reaped from game-ification of learning, it is crucial to also understand "under what circumstances game elements can drive learning behavior" (Lee & Hammer, 2011). Furthermore, game-ification of learning is not equivalent to turning learning or school into a game; instead it refers to the incorporation of game elements into formal education. However,

how can these elements be efficiently and effectively applied to educational endeavors are challenges facing teachers in the 21st century.

Conclusion

While it was once unthinkable that games could be learning tools, research today has demonstrated games are inherently learning environments that not only engage players but also motivate them to want to learn. The success experienced by games in bringing about learning lies in game interactions. Through a complex web of game mechanics, game designers effectively realized learning theories, leading players to a deeper understanding and appreciation of the game. Given the immense amount of time the young today invest in games and their familiarity with game mechanics and environment, it would be helpful to consider how the success in bringing about desired learning outcomes and engagement in the context of games can be transferred to formal education.

The proposed reframing of learning environment, teacher and student roles through the questions raised are but starting points of rethinking learning and formal education. The intent is to confront the reality that students are complex individuals participating in multiple networks and negotiating multiple worlds, and consider how to harness these complexities to aid learning. Whether or not this would require and/or lead to greater customization in learning, the author would not speculate, but this is potentially another issue to consider as we invest in students greater autonomy in their learning process.

References

1. Bruner, J.S. (1967). *On knowing: Essays for the left hand*. Harvard University Press.

2. Gee, J. P., Morgridge, T. (2007). *Good Video Games and Good Learning.* In *Good Video Games and Good Learning: Collected Essays on Video Games, Learning and Literacy (New Literacies and Digital Epistemologies)*. Peter Lang Pub Inc.

3. Greeno, J. (2006). Learning in Activity. In *The Cambridge Handbook of the Learning Sciences*. Cambridge University Press.

4. Hoffmann, L. (2009). Learning through games. *Commun. of the ACM* 52, 8 (Aug. 2009), 21-22.

5. "interaction, n.". OED Online. March 2011. Oxford University Press. 3 May 2011 <http://www.oed.com/viewdictionaryentry/Entry/97519>.

6. Lave, J., & Wenger, E. (1998). *Communities of Practice: Learning, Meaning, and Identity*. Cambridge University Press.

7. Lee, J. J. & Hammer, J. (2011). Gamification in Education: What, How, Why Bother? *Academic Exchange Quarterly*, 15(2).

8. Malone, T. W. and Lepper, M. R. (1987). *Making learning fun: A taxonomy of intrinsic motivations for learning.* Hillsdale, N.J.: Erlbaum, 1987, vol. 3, pp. 223-253.

9. Mayer, R. E., & R. Moreno (1998). "A Cognitive Theory of Multimedia Learning: Implications for Design Principles". http://www.unm.edu/~moreno/PDFS/chi.pdf.

10. Pavlov, I. P. (1927). *Conditioned Reflexes: An Investigation of the Physiological Activity of the Cerebral Cortex.* Translated and Edited by G. V. Anrep. Oxford University Press.

11. Pope, D. (2003). *Doing School: How We Are Creating a Generation of Stressed-Out, Materialistic, and Miseducated Students*. Yale University Press.

12. Reeves, B., Read, J. L. (2009). *Total Engagement: Using Games and Virtual Worlds to Change the Way People Work and Businesses Compete*. Harvard Business School Press.

13. Schell, J. (2008). *The Art of Game Design: A Book of Lenses*. Morgan Kaufmann Publishers

14. Schonfeld, E. (2010) SCVNGR's Secret Game Mechanics Playdeck. TechCrunch. 25 August 2010 <http://techcrunch.com/2010/08/25/scvngr-game-mechanics>

15. Skinner, B. F. (1950). Are theories of learning necessary? *Psychological Review*, *57*, 193-216.

16. Vygotsky, L.S. (1978). *Mind and society: The development of higher mental processes*. Harvard University Press.