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Author	Norman Kee Kiak Nam
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INFORMAL LEARNING FROM VIDEO GAMES OF THREE AUTISTIC CHILDREN IN  
A FAMILY: A CASE STUDY

Norman Kee Kiak Nam

NATIONAL INSTITUTE OF EDUCATION,  
NANYANG TECHNOLOGICAL UNIVERSITY

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## Abstract

Many autistic children are highly interested and motivated by computers (Goodwin, 2008; Grynspan, Martin & Nadel, 2007). Shafer (2006) in his book “How computer games help children learn” revealed that good computer or video games allow “*children to live in worlds that they are curious about, or afraid of, or want desperately to try out*” (p.24) and implicitly it is because they want to understand the rules, roles and consequences of those worlds. Autistic people do not have impairment in their understanding of physical causality, and may even be superior relative to mental-age matched controls (Baron-Cohen, cited in Wakabayashi, et al.,2007). The purpose of the case study is to explore for evidences of informal learning from computer and video games of three autistic children in family of author directly during period of study of one month and indirectly through reflection of past recollections of significant moments of observed learning. The children have played video games from Nintendo consoles (N64, game cube, Wii) , Nintendo portable devices (Advanced gameboy, DS) , Sony playstation console and online internet games and applications. It is the hope of this study to generate interest in considering using computer and video games in special education for learning and literacy (Gee, 2007).

INFORMAL LEARNING FROM VIDEO GAMES OF THREE AUTISTIC CHILDREN IN  
A FAMILY: A CASE STUDY

Autism spectrum disorder (ASD) is a neurological dysfunction in humans (Mesibov, Shea & Schopler, 2004, p. 19), impairing to different degrees the ability to communicate and socialize and having narrow range of interest and compulsivity (Heflin & Alaimo, 2007, p.17) . The current predominant interventions for ASDs are behavioral and cognitive-behavioral in nature (Martin & Christopher, 2008) where learning theory is essentially behaviorism (Wilson & Myres, 2000). The fundamental stimulus-response paradigm and token economy of behaviorism may not appeal to ASDs as they reach adolescence, where they may desire past physiological needs(token economy) into esteem needs based on Maslow's hierarchy of needs (Maslow, 1968), due fundamentally to their natural biological lifespan development in areas of physical, cognitive, emotional and social needs (Berk, 2004). I would personally reconsider using behavioral approach only for adolescent and adult ASD people. There is thus a real need to have an education approach that will address the higher level needs for self esteem and learning for life, especially when they reach adolescence. Moreover, many autistic children are highly interested and motivated by computers (Goodwin, 2008; Grynspan, Martin & Nadel, 2007). Shafer (2006) in his book "How computer games help children learn" revealed that good computer or video games allow "*children to live in worlds that they are curious about, or afraid of, or want desperately to try out*" (p. 24) and implicitly it is because they want to understand the rules, roles and consequences of those worlds.

I would like to advocate situated cognition and social constructivism in this paper, which is generally not considered in autism interventions, to address the need through use of video games. I have observed that my three adolescent sons with autistic spectrum disorder

(ASD) to varying degrees, are able to play and achieve some level of success with Nintendo DS and Nintendo Wii games, without the need to first read the game manual or refer to game hint books, which I will normally need to before I play. Their interest and perseverance in some games of interest have led them to intuitively not only discover the properties, rules and procedures that must be mastered in order to become a “player” (Rosas, Nussbaum, Cumsille, Marianov, Correa, Flores, Grau, Lagos, Lopez, Lopez, Redriguez & Salinas, 2003) but also to win the games, perhaps learning more through situated cognition (Wilson & Myres, 2000) of the complex environment of the games than from behaviorism.

I am excited about this observation and would like to explore how existing Nintendo games that are of interest to my adolescent autistic children could engage them in meaningful learning (Jonassen, Howland, Moore & Marra, 2003) through the games. The informal learning taking place is predominantly unstructured, experiential and noninstitutional and described by contrasting with formal learning (Berg & Chyung, 2008). In this study, the informal learning is operationalized through explication of meaningful learning attributes (Jonassen, Howland, Moore & Marra, 2003) observed as evidences of informal learning taking place while overcoming the challenges in game play.

#### *What is the problem?*

Autistic people do not have impairment in their understanding of physical causality, and may even be superior relative to mental-age matched controls (Baron-Cohen, cited in Wakabayashi, et al., 2007) . Thus there is a need to provide ASD children with learning environment that interest them, with affordances of cause and effect (or immediate feedback) that not only sustains their interest but also have the criteria that brings about meaningful learning (Jonassen, et al., 2003) . From research literature, computer games (Goodwin, 2008; Passerino & Santarosa, 2008, Huang, 2004) and video games (Gee, 2007a; Gee, 2007b;

Shaffer, 2006) are potential learning environments to address the needs. I have personally witnessed sudden switching off of desktop personal computer power due to frustrations, leading to corrupt operating or data when playing computer games. I therefore prefer video games learning environment running on dedicated game consoles like Nintendo DS or Nintendo Wii which are certainly more robust and generally designed to be idiot proof and immune to such anger behaviour. Moreover, video games are easier to manage as there is no need to patch the operating environment, configure the operating environment for game purpose,

Currently, there is no formal consideration in special education, for use of video games for learning by ASD children as there is no formal endorsement of its effectiveness for learning and therefore the current study addresses this lack of study. Two noteworthy and recent Ph. D thesis, “*Students’ use of social and cognitive affordances in video game play within educational contexts: Implications for learning*”(Sharritt, 2008) and “*The invention of good games: Understanding learning design in commercial video games*” (Becker, 2008) have gleaned from existing research literature and revealed the need to describe actual uses of video games for learning (Sharritt, 2008) and how commercially and critically successful modern video game supports learning that players must accomplish in order to succeed in the game (Becker, 2008). As both of these recent completed studies are working on neurotypical (mainstream) children, it would be reasonable to infer that research in using video games for non neurotypical children, such as ASDs, in learning would also be in infancy or lacking.

#### *How has it been addressed in the literature?*

Many people with autism are highly interested and motivated by computers and computer-assisted learning, where they can focus on numerous academic and support areas of need such as emotion recognition, social interaction, and communication (Goodwin, 2008;

Passerino & Santarosa, 2008; Huang, 2004). Educational computer games can be dispensed with great success for the right tasks but have clear limitations and require qualified teachers that can serve as facilitators of learning (Egenfeld-nielsen, 2007).

Annetta (2008) and Gros (2007) have both expounded in their papers that much research remains to be done on video games in education. Gros (2007) insightfully summarized the current status as :

The educational use of computer games is not unexplored research territory, but research is disjointed and the field lacks well-defined boundaries. Research has been distributed over a number of disciplines with little in common except perhaps the interest in computer games. Some of these are literature, psychology, media studies, anthropology, ethnography, sociology, history, business studies, military tactics, literary theory, educational, theory, instructional technology and computer game studies. (p. 24)

Moreover, searching for peer-reviewed journals for key words, “video games” and “Autism” did not reveal any published peer-reviewed literature on learning of ASD children through video games from electronic databases such as ERIC and Proquest (done on 3<sup>rd</sup> March 2009). Though I found a preview Ph. D. dissertation title “ Social Skills and Dyadic Computer Game Playing with Autistic children” submitted by Marlene, N. Scholl from Northcentral University in June 2006 (UMI Number:324713), it did not address video gaming. Most published peer-reviewed research on video gaming involves neurotypical (mainstream) children, though there are some non peer-reviewed magazines (Busch & Markle, 2009) and online sites (Susan, n.d.) that have topics on it. It is the hope of this study to generate interest in considering using video games in special education for learning and literacy (Gee, 2007).

### *Purpose of the Study*

In view of the potential that existing Nintendo video games of interest to my adolescent autistic children could engage them to learn the rules and even win many game levels without the need to refer to manuals, it is the purpose of the study to learn not only how they could have meaningfully learnt how to play and win but also explore how to harness the informal learning for suitable curriculum learning and literacy, with appropriate scaffolding when and where possible.

### *Research questions*

1. How does existing Nintendo games that are of interest to my adolescent children, engage them in meaningful learning (Jonassen et al., 2003) of the games?

### *Theory Statement*

Good video games (Gee, 2007a) can simulate worlds that provide a safe environment to let them explore. Shaffer(2006), explains that children in the process of playing, are:

*“doing explicitly, openly, and socially what as adults they will do tacitly, privately, and personally. They are running simulations of worlds they want to learn about in order to understand the rules, roles and consequences of those world. They are learning to think by examining alternatives in play”* (pp. 24-25).

Implicitly, the theoretical perspective adopted is social constructionism (Crotty,1998), that is transactional and subjective (Guba & Lincoln, 2005) as game players will need to directly interact with the game environment and game avatars and make sense using situated cognition (Jonassen & Land, 2000) learning. The “social” in social constructionism need not involve persons (and therefore need not be ‘social’ in that sense.) (Crotty, 1998) but rather with computer artifacts, that interact and transact with the player of the game. Interaction of the ASD children with the objects and environment created by the simulated world is social.

My ontology is relativism (Guba and Lincoln, 2005) that is realities perceived by the game players are local and specific constructed and co-constructed realities (with facilitators). It is assumed that these interactions will cause mental transactions that lead to learning. The epistemological view is thus transactional and subjectivist where the constructed knowledge also depends on the background experiences of the ASD child and the subjective interpretation of the transactions. Crotty (1988) has identified the work of Karl Mannheim (1893-1947) and from Berger and Luckmann's *The Social Construction of Reality* (1967) to be the key scholars in social constructionism. I have found the works of James Paul Gee (2007a, 2007b) and David Williamson Shaffer (2006) key to understanding what video games have to teach or help children learn. The characteristics identified as good video games and for good learning will be used to assess the existing games (Gee, 2007a) for selection for this study and the possible effects of learning for study from the transactions with the game consoles will be drawn from Jonassen, et al., (2003) from their explication of attributes of meaningful learning, which necessitates the experience to be engaging in doing the learning activities.

The social constructionism framework allows me to do a case study research methodology to study what, how and why the existing games may have the potential to bring about development of desired learning processes (e.g. meaning, self-regulation, incidental learning, conceptualization, motivation and higher-order processing). There is no requirement to control the behavior events as the theoretical framework assumes that learning is constructed through the 'social' interactions of the ASD child with the video game simulated environment locally and specifically, a contemporary (current real life) event (Yin, 2009). It would also be valuable to reflect in retrospect what types of cognitive processes are affected by certain categories of selected games(e.g. simulation, action) as classified by Herz

system (1997, cited in Rebetez & Betrancourt, 2007). The different selections are necessary as the interest and degree of autism varies between the studied subjects.

The research will be extended to explore how to design and evaluate effectiveness of activities and scaffolds that complement the game playing activities for learning of suitable curriculum (e.g. expressive language, mathematical concepts, music) for adolescent autistic children.

My personal observation over the years of the studied subjects reveals implicitly that social constructionism is most likely the theoretical framework that explains their learning and discovery of the world around them. Egenfeldt-Nielsen (2007, 2005) in his research paper and Ph.D. thesis reported support and use of constructionism theoretical framework to complement in his empirical study as it provides the richer insight and details to what is happening.

#### *Subjectivities Statement*

As my objectivity as a researcher is situated within subjective thoughts influenced by my personal histories, cultural worldviews and professional experiences (Lewis-Beck, Bryman, A., & Liao, 2004), I would like to explicate these influences and will thus be aware of how my subjectivity may shape my research inquiry and its outcomes (Peshkin, 1988), in the desire to collect trustworthy data in this study. I am the father of the three autistic children in this study and have conducted research on autism using case-based research methodology with two of my children with findings presented in a conference in 2007 (Kee, 2007). Being their father, I have in-depth knowledge of their development and personality since birth and may be objective and subjective at the same time, in determining whether the learning observed is directly from the game playing event or possibly from past experience. I have taken courses on qualitative research methodologies as part of my two masters programme in National University of Singapore and Nanyang Technological University.

Essentially my view of ASD is that all individuals are unique and may learn or appreciate the same learning situation differently due to their sensory and perceptual differences as well as cognitive differences, even though they have some common autistic traits. I believe this also happens to neurotypical (mainstream) adults, as my experience with the student teachers taking the same lesson within the institution, reveal different levels of perceptions and understanding of the same learning event, such as watching of an educational video. Personally, I have observed that my children construct their own knowledge in different ways, as they generally do not like instructions and learn more by exploration and observation of others than by didactic means. My ontology is thus relativism (Guba and Lincoln, 2005) where realities are local and specific construction by learner and/or co-construction realities when interacting with others in social-cultural context (Crotty, 1998). Consequently, my epistemology is social constructionism that is transactional/subjectivist (Guba and Lincoln, 2005) as I have observed variation in my children perception and appreciation of the same physical events.

I have also chosen to use my reflections/recollections of past historical significant events of my sons learning of the games before the research, as part of the research data, as I believe the data will provide useful insights into addressing practical problems (Lewis-Beck, et. al., 2004) such as how to get autistic children to learn to play video games, when it may be difficult even for some adults. I admit that this data is not methodically collected but only in retrospect, as there was no research questions while I was observing. However, with my training as an educator and researcher, the inductive findings may add knowledge to the research field as they were derived from insights over long period of informal observations as a father, educator and researcher.

## RESEARCH DESIGN

Case study research methodology is selected as the research requires the understanding of the complex phenomenon (Yin, 2009) of how my autistic children are engaged in meaningful learning of Nintendo video games informally as in natural home settings, and how I may harness the informal learning for suitable curriculum learning. The processes are considered complex as ASD children have differences in neurobehavioral patterns and thinking (Mesibov, et al., 2004) when compared to non-ASD children and also between individuals with ASD, where learning needs to be inferred from contextual behavioural information and game output. Moreover, I have little or no control and no requirement over their behaviour (Yin, 2009) to construct learning as the focus is on studying within a real-life context while they are playing video games, a contemporary phenomenon and not a historical event (Yin, 2009). Yin (2009) has advocated that studies meeting the three mentioned conditions are apt for using case study research method.

Case study research method “*remains one of the most challenging of all social science endeavours*” (Yin, 2009). Not many researchers used this method for studying autism. I found one study by Johnson (2006), who use case study research method for his Ph. D. dissertation title “*The effects of autism on families and educators: A case study.*”. Others may study cases but using single case research design (Horn, Lieber, Li, Sandall, & Schwartz, 2000). However, in other disciplines, such as rehabilitation studies, case study research method is being used (Alan, 2009).

The research setting will be my home. This is needful as autistic children requires a safe, predictable, orderly and structured environment with understanding of the “culture of autism” and TEACCH work system (Mesibov, et al., 2004), as well as familiar people to work with before learning can take place. My children are selected for the study as there is also a need for researcher to understand their temperament, habits and ways for effective

communication and rapport to facilitate and scaffold an environment where informal learning can take place and also for ASDs participants to know and be comfortable with the researcher. Home site with family member as researcher, naturally satisfies the conditions for suitable environment for informal learning environment facilitation for ASD children learning. Moreover, as my three adolescent children have autism to different degrees (high functioning, moderate and mild), they meet the criteria for independent cases suitable for multiple holistic case study research design, where each need to be an adolescent with autism and comfortable with working with the researcher.

The research methodology adopts Yin (2009) five components of research design, using a multiple-case replication design as below:

1. *Study's Research questions*

RQ1. How does existing Nintendo games that are of interest to my adolescent children, engage them in meaningful learning (Jonassen et al., 2003) of the games?

2. *Corresponding Study Propositions (CSP) to operationalize research questions*

*CSP1.* Video game playing engages them in meaningful learning by building in opportunities for active manipulation of the game objects with corresponding observation of the effects of what they have done (Jonassen, et al., 2003)

*CSP2.* Video game playing engages them in meaningful learning by building in opportunities to construct their learning by articulating and reflecting on their game playing experiences (Jonassen, et al., 2003).

*CSP3.* Video game engages them in meaningful learning by building in opportunities for intentional learning to fulfil some goal (Jonassen, et al., 2003).

*CSP4.* Video game engages them in meaningful learning by simulating an authentic game playing environment that is complex and contextualized requiring students to solve

complex and ill-structured problems as well as simple, well-structured problems (Jonassen, et al., 2003).

*CSP5.* Video game engages them in meaningful learning by building in opportunities for collaborative and conversational learning with the game artefacts (Jonassen, et al., 2003).

### 3. *Units of analysis*

There are three units of analysis or cases; subject 1 : very high functioning ASD child in express stream of mainstream school, age 14; subject 2: moderate functioning ASD child, age 13, with intelligence quotient (IQ) of 55; subject 3: high functioning ASD child, age 12 with IQ of 72. Mental retardation is defined by three criteria: cognitive impairment of IQ scores less than 70, adaptive skills deficits, and age of onset prior to 18 years (APA, 2000 cited in Edelson, 2006). Thus only subject 2 has mental retardation.

### 4. *The logic linking the data to the propositions.*

*CSP1.* Observation data will be gathered on evidences of active manipulation with corresponding visual feedback where learner is able to accomplish certain goals of game. Humans of all ages generally can develop sophisticated skills and construct advanced knowledge meaningfully as they interact with their environment and manipulate objects in that environment to fulfil what they need or want to do, through observing the effects of their interventions and constructing their own interpretation of the phenomenon and the results of the manipulation (Jonassen, et al., 2003, p. 7). Similarly it would be expected that video games that provide such affordances will also result in meaningful learning.

*CSP2.* Data will be gathered by observing for evidences such as pauses where player can be seen intently looking on and appear to deliberating on what to do next, resulting in the eventual overcoming to challenges to accomplish certain goals of game. It is expected that good games will create puzzlement, a catalyst for meaning making. By reflecting on the puzzling experience, learners integrate their new experiences with their prior knowledge or

establish goals to make sense of what they observe (Jonassen, et al., 2003, p. 7), generating meaningful experience of learning.

**CSP3.** Learners who fulfil an intention after thinking and articulating their intention will learn meaningfully. In this study, I am inferring that if user is observed to actively and wilfully trying to achieve a goal, he is explicating intentional learning data (Jonassen, et al., 2003, pp. 7-8).

**CSP4.** Observed evidences from game play will be gathered on the authenticity of the game playing environment by considering the game playing elements (e.g. number of social artifacts (video game actors generated in environment), parameters affecting game play, number of possible routes, options available, degree of ease of play to infer degree of structured problems in game play). Most contemporary research on learning has shown that learning tasks that are situated in some meaningful real-world task or simulated are better understood (Jonassen, et al., 2003, p. 8)

**CSP5.** Observed evidences for collaborative and conversational learning with game artefacts and facilitator will be collected as humans naturally seek out others (human or game artefact) to help them to solve problems and perform tasks, in learning and knowledge building communities (Jonassen, et al., 2003, p. 8)

##### 5. *The criteria for interpreting the findings.*

Jonassen et al., (2003) has explicated that meaningful learning has five interdependent attributes of active (manipulative/observant), constructive (articulative/reflective), cooperative (collaborative/conversational), authentic (complex/contextualized) and intentional (reflective/regulatory) with learning accomplished inferred by participant able to complete the game activities or task. If the existing Nintendo games used are engaging, with evidences of the five attributes of meaningful learning and accomplishment of game activity

goals, then I would infer that observation of the five attributes are evidences of informal learning taking place.

#### *Case Study Protocol: Data Collection Plan*

There are altogether two sessions in this research, where each will be given a new Nintendo Wii game to work through. Each session will be about an hour. If any game should prove uninteresting, another game would be offered. The output of the video game will be captured in digital video recorder with concurrent videoing of their physical playing.

*Session 1.* Participants will select game of their interest and play for about an hour;  
Recording game console video data with video recorder of participant 1, 2, 3;  
Recording game play video data with video camera of participant 1, 2 and 3;  
Researcher Retrospective Reflection to be integrated in discussion.

*Session 2.* Participants will continue with selected game for another hour.  
Recording game console video data with video recorder of participant 1, 2, 3;  
Recording game play video data with video camera of participant 1, 2 and 3;  
Researcher Retrospective Reflection to be integrated in discussion.

#### *Validity of Design*

*Construct Validity.* The construct validity of the research design is by establishing chain of evidence with documenting progress of learning through checking for the listed evidences of the corresponding study propositions during data collection and thereafter triangulation of analyzed findings from video from video recorder, video from video camera, and retrospective reflection integrated in discussion.

*Internal Validity.* The internal validity is build using pattern matching and explanation-building within and between cases.

*External Validity.* The external validity is build using replication (multiple cases) of high functioning, mild and moderate ASD child.

*Reliability of Design.* The reliability of the research is established by using case study protocol. This involves using the same procedures for starting the study, collecting data and analyzing data.

## RESULTS

### *Game Titles Selection*

**Subject 1 (very high functioning ASD)**, browse through the titles in a game shop and selected Nintendo Wii game “*Star Wars: The Force Unleashed*” from Lucasarts. The game is rated Teen Violence by Entertainment Software Rating Board (ESRB). The game bridges the two Star Wars trilogies and introduces a new protagonist, Starkiller, as Darth Vader's secret apprentice. When asked why he selected the game, the reply was that he prefers games where there is lots of action, based on movie that he is familiar with, like “Star Wars” and involves human like avatars with good realistic computer graphics, animation and sound.

**Subject 2 (moderate functioning ASD)** selected Nintendo Wii game “*Mario Super Sluggers*” developed by Namco Bandai and published by Nintendo. The game is rated for Everyone by ESRB. It is a baseball sports video game. My son has showed me a number of times on his computer screen that he is interested in this game.

**Subject 3 (high functioning ASD)** did not want to select a game so I suggested “*Animal Crossing: City Folk*” developed and published by Nintendo to him. As he did not mind, I got the game for him. The game is a simulation of living in a town as has been reported to be educational in a magazine (Busch & Markle, 2009).

*CSPI*. Yes, the findings for all three revealed that the games did build in opportunities for active manipulation of the game objects with corresponding observation of the effects of what they have done as below:

Subject 1 (very high functioning ASD).

Subject initially assumes Darth Vader personality. Just in time onscreen graphic instructions (through pictures of controller and the way to manipulate) are being flash to teach how to use controllers (Wii Remote and Nunchuk) for a specific attack/defend which he comprehends. Various objects and enemies are then in the way for him to exercise the skills repeatedly. Subject1 eventually assimilates the skills through overcoming various challenges of his enemies, objects and enemy fires. Competency in using the skills gradually develops through the constant active manipulation of the game controllers with visual and audio feedback on how well the execution of the skills was. By five minutes he has grasped the basic skills and exercised the skills to complete the first stage within ten minutes. A new video demarcates one stage from the next. Throughout the game, such strategy of just in time learning of required skills with constant presentation of enemies to exercise all the skills shown for survival are used. When failure to use certain skills are detected by the game intelligence, visual hint of how to execute the powerful attack maneuver is superimpose on the scene in context to provide immediate aid. Subject 1 manages to complete the game in 10 hours.

Subject 2 (moderate functioning ASD)

Subject does not read written instructions and will quickly skip the written and graphic instructions. He will however read the graphic instructions when he fails multiple times or when the superimposed controller is graphically and explicitly shown with large arrows while in game play game for just in time coaching. He eventually masters the basic skills (batting : normal swing, fielding: throwing the ball) through learning with the active manipulation and

immediate feedback with plenty of opportunities to correct and fine-tune his batting or fielding skills in baseball by twenty minutes.

Subject 3 (high functioning ASD)

Subject likes to have fun and quickly skips screen instructions and only reads when a response is required. Through trial and error and active manipulation and observing the immediate feedback of game affordances, he gradually learns the basics of the game by himself (e.g. assessing menus, reading maps, walking to different houses, pushing trees to drop pears, pick up pears, checking his pocket for items) within 8 minutes.

**CSP2/CSP3/CSP4.** The findings for all three subjects in their respective games shows that CSP2, CSP3 and CSP4 are closely inter-related and evident in the observations.

Subject 1 (very high functioning ASD).

“Star Wars : The Force Unleashed” started with a cinematic movie clip with fantastic 3-D animations, impressive computer graphics, immersive soundtrack and compelling storyline, where he quickly relates to, as he has watched the Star Wars movies series, including the existing current television series run of Clone Wars, a computer generated animation show. He assumes the identity of infamous Darth Vader, who is a very powerful Jedi and fights his way in the first mission. The game environment does certainly simulate an authentic environment as it not only looks like the movie environment but he also moves, sounds and have the power like Darth Vader (able to lift enemies and fling them around through using his force). The thought and opportunity to try out the dark powers of Darth Vader with realism in the game makes the gaming environment engaging, contextualized and complex (CSP4) as what is going to happen next is an unknown as evidenced from total attention to the game play (eyes glued with synchronised hand coordination without signs of fatigue) . The intentional learning of wanting to discover how to unleashed the power of a powerful Jedi has certainly lead subject to learn by try different techniques (CSP3) as evidenced by him

referring to menu options for more information on the arsenal and how best to increase the power, whereby reflection and constructing of the knowledge is expected especially when the new skills (saber lock, force lock, dash, finishing moves, etc) are integrated and used appropriately and dynamically with enemy attacks that are incessant and powerful(CSP2). Completing each stage is rewarded with another cinematic video clip that provides the context (CSP4) for the new mission to complete (CSP3), where new skills of new found tools (e.g. Jedi Holocron) are presented in each stage to master (CSP2).

### Subject 2 (moderate functioning ASD)

Subject 2 is captivated by the starting video clip showing a grand entrance of the familiar Nintendo characters as they gather to compete with each other in baseball, as he does not skip the video each time he starts the game, his eyes are focused on the screen even though he may close his ears due to sound sensitivity and he also watches a recording of it repeatedly on the Internet YouTube. He is probably imagining himself as Luigi, his favourite character, as he selects Luigi to be the captain of the baseball team and plays carefully when Luigi is batting or fielding. The game environment does certainly simulate an authentic environment as he can move around with familiar characters and can interact and play baseball games with. The thought and opportunity to be Luigi and play baseball with realism in the game makes the gaming environment engaging, contextualized and complex (CSP4) as physics of the batting, fielding and ball projectory are realistic as evidenced by his total attention to the screen with happy sounds and jumps. The interplay between characters in the baseball team is also complex to coordinate. As he enters the challenges in the game, he can be observed to intentionally learn new skills (CSP3) by his attempt to try out the just in time graphic instructions showing how to move the controllers superimposed on the game play. With trial and error practice and watching the immediate feedback, he probably reflected on his game

play experience and constructs his learning on execution of the skills required (CSP2).

Evidence of learning is observed by his mastery of the skills in game play.

Subject 3 (high functioning ASD)

Game created an authentic and engaging environment with good computer graphics and realistic animations and by allowing player to decide own name, name of town, date and time of game play (Rover the cat act in disbelief (big bewildered eyes) of the set date/time/year (2035), but accepted all the settings nevertheless) and travelling on a bus towards a town named after subject choice, with revealed option to buy house and find work. As subject is fun loving with mischievous trait, he was elated when all the settings were accepted and enjoyed the interactions with Rover as his facial expressions were funny. He appeared engaged and looking forward to what comes next (CSP4). With arrival of the bus in town, he alighted quickly and did not read instructions to go to town house. He quickly walks around to explore the town, an intentional learning activity (CSP3) and through trial and error and probably reflections construct learning of the value of the map in relation to his game play positions as evidenced by frequent comparing of his position to the map (CSP2).

**CSP5.** All three subjects did seek opportunities for cooperative(collaborative and conversational) learning with the game artefacts and facilitator to different degrees depending on functioning and literacy level.

Subject 1 (very high functioning ASD).

Subject has been observed to search the Internet and converse his other classmates on techniques, strategies, hints and game cheats to win the game, a cooperative (collaborative and conversational) learning with his social network and network resources(CSP5).

Subject 2 (moderate functioning ASD)

Subject when encountering frustrating situations have approached facilitator for help.

Through the interactions with subject and the game, subject learns the need to be patient

enough to read the screen instructions that are not superimposed, by deliberately refusing to help, claiming ignorance except through reading of on screen hint instructions when it appears. The frustrating situations of losing multiple times have probably created opportunities for cooperative(collaborative and conversational) learning (CSP5).

### Subject 3 (high functioning ASD)

The challenges for subject greater because the just in time instructions are ignored. Only after failing many times does he read the instructions. His pride and desire to boast of success prevented him from asking for help. For example, he has to greet everyone in town before he is given part-time work by Tom Nook. As he was not careful in checking the menu for names on whether he has seen everyone by using the map, he did not complete the task of greeting everyone after half an hour. He was visually showing boredom. I have to intervene to encourage him to use what he does know to check the information by prompting. He eventually completes the greeting within the hour and starts getting work. He managed to write letters, write on bulletin boards, work for financial gains, paying off his mortgages of his house. With some help and encouragement by one hour and twenty minutes, he no longer works for Tom Nooks as he finished all the part-time work and started working for himself by fishing, harvesting pears, growing plants and collecting seashells with many interactions of transactions with Tom Nook (CSP5) and reading the instructions.

## DISCUSSION

The findings from this limited study revealed that autistic children can and do learn informally from video games to different degrees, depending on the functioning and literacy level, the intended skills and understanding from the design of commercial off the shelf (COTS) popular games of established game publishers such as from Nintendo and Lucasarts. The common findings from all three subjects reveal that they do not read manuals or even onscreen instructions unless they consider it important to do so. The subjects would prefer to

go straight into playing the game and learn how to play through trial and error or learning by doing (Jonassen, et al., 2003). Establish game publishers are probably aware of this trait and provide just in time visual guide or hints which are simple, superimposed onto the screen in game play when need arises, such as introduction of new skills or repeated failures to use required skills are detected. The active manipulation of affordances of the game and the immediate visual and audio feedback (CSP1), coupled with diverse and numerous opportunities to practice the skill in game context, certainly aid in meaningful learning and assimilation of the required manipulative skills needed to overcome the challenges. This also provokes, promotes and support the player to want to intentionally learn the skills and strategies (CSP3) needed to win by providing just in time, visually simple and direct help. The constant onslaught of instances to use skills with immediate feedback probably helps in the construction of learning of the skills as well as assimilation. The sampled subjects supports the finding that autistic people do not have impairment in their understanding of physical causality (Baron-Cohen, cited in Wakabayashi, et al.,2007). Reflecting on the current and past observations, autistic people learnt best when the game information presented is visually clear, simple, singular in purpose and timely. For example, graphic pictures of the physical game controller with large arrows to show direction to manipulate the controller, superimposed in game play, provides immediate that is very clear and to the point without distractions. It is also apparent from past reflections and existing study of the need to allow for freedom to explore the game environment and have fun, such as to walking around in and out of different sub-game environment and to play with the artefacts to have fun. For example, subject 3 likes to find snow balls and roll them around until they become very big and then either use it to block doors of other town residents or to throw into the river and see it bob up and down dissolving and becoming smaller with time. Perhaps, in retrospect, the need arises is due mainly to our need to do something when we do not know what to do,

frustrated or looking for simple fun to amuse ourselves out of boredom. Nintendo is certainly very aware of this human trait and has catered for it.

All three subjects are observed to need captivating and compelling reasons to want to play the game, normally facilitated by watching the starting video trailer of game, which encapsulates the authentic, complex and contextualized game environment (CSP4). The high quality graphics, sound effects, computer animation, realistic movements of avatars and objects and interactions, together with the affordances described earlier (CSP1,CSP2, CSP3) created an immersive environment where situated cognition of the game subjects is transactional with the game artefacts and subjectivist depending on the background knowledge and ability of the subject. All three subjects actually sought when the difficulty level was high through the game artefacts, facilitator and/or the social networks available(CSP5). The informal learning witnessed is thus through social constructionism.

A potential area for further research is the use of games such as “*Animal Crossing: City Folk*” to help autistic people learn and understand a representation of a society with all its activities that encapsulates the life in society . For example, subject 3 makes his living in the game by catching and selling fishes, harvesting and selling pears to Tom Nook and uses his earnings to pay his mortgages for his house. He also generously donate some of his earning to charity and also buys and decorates his home with many different type of furniture. Currently, it is not easy to find ways to help autistic people acquire such complex concept like society. The game allows “*children to live in worlds that they are curious about, or afraid of, or want desperately to try out*” (Shafer, 2006) and implicitly it is because they want to understand the rules, roles and consequences of those worlds. Moreover, it also provides a safe virtual environment to understand the potential reality of surviving in a real world, with room for failure and making learning experiences less painful, compared harsh realities of life.

## CONCLUSION

The current study findings reveal that Nintendo games that are of interest to my adolescent children engage them in meaningful learning through incorporation of the five attributes of meaningful learning proposed by Jonassen et al.,(2003). The study also supports the effectiveness of just-in-time simple and direct visual instructions superimposed in game play, fun elements and opportunity to explore game environment in game design for autistic people. A potential area for further research is the use of game simulation of virtual worlds to help autistic people learn, appreciate and survive in our complex societies, safely and without being scarred by the harsh realities.

## LIMITATIONS OF STUDY

There are several limitations noted in this study. These are mentioned briefly below:

1. The author acknowledged that the study and reporting could be more detailed. The author allowed the subjects to choose the games just before the study started, so that they would be interested to play the new games. As a result, author did not master the games before starting the study and learnt at the same time with the subjects during game play.
2. The author encountered technical problems in processing and transcribing the videos in Windows Vista, reducing time for reporting.
3. The planned scope of the study was originally larger but was reduced when technical problems were encountered.

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