

Utilizing Massively Multiplayer Online Games to Foster Collaboration and Learning

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Abstract-Successful integration of traditional learning objectives with elements of entertainment becomes the goal for the design and application of video games used for educational purposes. Oftentimes assumptions are made that students who are not gamers can play video games and reap the pedagogical benefits of gameplay without experiencing a learning curve relative to understanding game objectives. We argue that inexperienced players encounter two different trajectories of learning: the cognitive process associated with understanding how to play the game and the cognitive processes embedded in gameplay activities that correspond to domain specific learning goals. These dissimilar trajectories of learning create competing goals for the player who portrays dual roles of student and novice gamer. We examine this dilemma in the context of second language students who play a Massively Multiplayer Online Role Playing Games for the purpose of improving their English proficiency skills. We utilize statistical analysis to evaluate English as Second Language (ESL) students' ability to acquire second language vocabulary. Results indicate positive learning outcomes for vocabulary acquisition of ESL students who participate in collaborative gameplay with Native English Speakers, emphasizing the role of social interactions in second language acquisition. However, visual analysis of game logs measures the learning trajectory associated with completing game tasks and reveals that ESL students who play EQ2 independently achieve increasing levels of virtual character progression in less time than their peers.

I. INTRODUCTION

Advocates of video games as pedagogical tools argue that video games leverage the elements of entertainment, challenge, and fun to promote learning as a key component of gameplay experiences [4, 7, 20] Critics of video games as educational tools warn against simply embedding

educational technology in sophisticated graphics, indicating that a more deliberate design process that integrates learning objectives with entertainment is needed to develop educational video games that promote positive learning outcomes [3,7].

One approach is to design video games commonly referred to as serious games that promote transfer of knowledge or skills developed in the virtual realm to the real world. However, serious game designers must be able to successfully manage the tension between entertainment and correlating domain specific learning objectives with game tasks. In the case of loosely coupled educational content with gameplay mechanics, students may lose sight of domain specific learning goals as they become more concerned with achieving a winning outcome. On the other hand, tightly integrated game tasks with learning goals do not necessarily lead to enjoyable gameplay experiences for players or positive learning outcomes [3]. Therefore, it is important to evaluate the relationship between learning associated with accomplishing gameplay activities to the domain specific pedagogical benefits intended for novice players [4].

Oftentimes, the assumption is made that students who are not gamers reap the intended pedagogical benefits of gameplay without experiencing the learning curve associated with understanding how to play the video game. Consequently, inexperienced players who portray the dual roles of novice gamers and students encounter two different trajectories of learning: 1. the cognitive process associated with

understanding how to play the game (e.g. navigation of game controls, manipulation of resources for completing game tasks, etc.); and 2. the cognitive processes embedded in gameplay activities that correspond to domain specific learning goals [4, 7, 12, 13]. These two different trajectories of learning can sometimes represent competing goals for the student and possibly impede domain specific learning goals.

In contrast to developing a serious game that aligns game tasks with specific learning goals, we choose to re-purpose the popular recreational Massively Multiplayer Online Role Playing Game (MMORPG) EverQuest® II (EQ2) as a pedagogical tool, leveraging social interactions typical of gameplay experiences as a crucial learning task for Second Language Acquisition (SLA). Prior research reveals that social interactions with players during gameplay assist novice players with comprehending game objectives and that these social interactions enable novices to accomplish game tasks [9, 12, 14, 16]. However, less is known about the interdependency of in-game social interactions among players and their impact on individual learning achievements relative to SLA [11, 12].

In response to this dilemma, we examine the relationship between the two learning trajectories: 1. English as a Second Language (ESL) students learning how to play EQ2 and 2. ESL students increased proficiency in English vocabulary acquisition. First we review the learning opportunities attributed to gameplay experiences in MMORPGs in section 2. In section 3 we outline the details of the game study and review learning outcomes attributed to ESL students who play EQ2 independently versus those ESL students who interact with Native English Speakers (NES) during collaborative gameplay. Using the visualization tool ClockWerk, we conduct content analysis of ESL students' game logs to identify the interdependency between in-game social interactions and the two different learning trajectories to correlate collaborative gameplay to positive learning outcomes. Finally, we discuss the implications for utilizing MMORPGs as effective SLA pedagogical tools.

II. LEARNING OPPORTUNITIES PRESENT IN EQ2

Gee [4] proposes that we can learn a lot from video games. In a similar vein, EQ2 provides ample opportunities for players to understand the rules of play and accomplish various game tasks as players evolve their selected avatars. Acknowledging that there are a plethora of concepts that novices or newbies must learn, we identify two different learning trajectories: 1. learning tasks for progression of gameplay; and 2. learning tasks that facilitate SLA. Virtual character development, combat and management of resources refer to learning tasks associated with progression of gameplay. In-game social interactions augment reading comprehension skills, vocabulary acquisition and communicative competence skills required for SLA [12]. We discuss each learning activity below.

A. *Virtual Character Development*

The goal of MMORPGs is to evolve the Player Character's (PC) avatar from level 1 which represents a newbie to ultimately level 80, an expert PC, by completing numerous quests or game tasks [10]. The structure of MMORPGs supports character evolution, one of the primary goals of gameplay. Each player selects a virtual character from good, evil or neutral species of avatars, customizes the appearance of the chosen avatar, and assumes the role of his/her virtual character [10]. Species of avatar has strengths and weaknesses that can be used strategically during gameplay. For example, an avatar who is a member of the *shaman* class has the innate ability to cast spells but lacks the physical prowess necessary for hand-to-hand combat. Thus, each player must grasp the capabilities and hone the strengths of his/her avatar so the avatar's abilities can be fully utilized to successfully complete game tasks and aid in forming strategic alliances with other players. Failure to understand and utilize the innate abilities of an avatar can result in temporary loss of capabilities, weakened health, and/or death.

B. *Attack and Defense*

Quests describe challenges that provide opportunities for character advancement (e.g. achievement points). Upon entry into the virtual world of Norrath, newbies are given the first quest of learning the art of combat based using their chosen avatar's innate abilities. Each player engages Non Player Characters (NPCs) or computer generated virtual characters that possess different capabilities (e.g. weak sparring partner vs. formidable sparring partner) in combat. For example, a dirge, a member of the *bards* class, plays songs to create a sense of hopelessness and despair in her enemies. Understanding how to recognize an opponent, defend oneself, and attack becomes a matter of life and death in the game world. Though the consequences are not fatal, they do weaken the PC, depleting strength and health. Similar to other Massively Multiplayer Online Games (MMOGs), PCs can engage in combat with formidable NPCs as well as PCs [14]. Thus, it is imperative that newbies quickly gauge the strengths of their character in battle, and continuously acquire appropriate skills to improve their defense strategy. Failure to do creates a continuous cycle of death and revival of avatar which prevents the newbie from completing quests and hinders virtual character progression.

C. *Management of Game Resources*

Typical of most video games, players must learn to manage resources, including weapons, attire, monetary and non-monetary rewards from encounters, and information as part of the gameplay experience. In EQ2 PCs pay a blacksmith to repair combat equipment, replenish the strength of their avatars by eating and drinking, and sell items in inventory to make a profit used to acquire additional resources. Additionally, players manage information (e.g. experience level of foes, map of virtual world, journal of quests, etc.) displayed on the screen to determine next course of action. Thus, PCs must be able to locate, interpret, and utilize the information present in the virtual world in order to accomplish multiple game tasks, an indicator of literacy [8, 16]. Lack of information makes it difficult for newbies to understand and achieve the objectives of the game

since helpful hints and feedback are oftentimes displayed on screen or available in supplementary materials (e.g. spell book). Newbies have to determine from the wealth of information available from multimodal sources which information is pertinent to the game task at hand. This introduces the learning tasks of first identifying and then synthesizing the information to determine game strategy.

D. *Vocabulary Acquisition*

SLL encourages vocabulary acquisition in terms of cultural context as being critical for developing proficiency in the target language [1, 5, 6, 17, 21, 22]. Vocabulary acquisition serves as the foundation for second language students to develop grammatical competency and reading comprehension skills [5, 6, 22]. Prior research demonstrates that MMORPGs provide a context for second language students to acquire vocabulary words [10 – 12]. MMORPGs utilize audio, text, symbols, gestures, and sophisticated graphics to create semiotic domains, a set of practices used to communicate meaning and provide a context for players to understand the information present in the game world [4]. Though MMORPGs introduce specialized vocabulary (e.g. goblins) that is specific to gameplay activities, Rankin et al. [11] demonstrate that MMORPGs provide a rich source of academically relevant vocabulary for advanced ESL students.

E. *Reading Comprehension Skills*

EQ2 requires a certain degree of literacy that enables PCs to effectively participate in gameplay [4, 12, 15]. In fact, most of the information is conveyed using text, requiring players to be proficient in English reading skills. Though some NPCs have audio which aids in listening skills, every NPC's speech is displayed as text on the screen. Consequently, foreign language students develop reading comprehension skills in the target language as they translate Non Player Characters' (NPCs) speech to determine the next course of action and process pertinent information to complete quests. As previously mentioned, MMORPGs make information readily available in

quest journals, spell books, knowledge books which outline the strengths and abilities of various species, and help menu interact with other PCs [10 – 12, 14]. Newbies can access any of these resources to improve their English reading comprehension skills.

F. *Communication Skills*

Communicative competence is defined as the student's ability to determine the appropriate use of language based on circumstances and is critical to communicative fluency in the target language [6, 17]. MMORPGs such as EQ2 are designed to create and support social networks of gamers [2, 9, 18]. Powerful alliances play a key factor in gamers' abilities to defeat enemies and accomplish tasks that are virtually impossible to perform alone [2, 9, 14]. Chat-based interactions with native speakers give ESL students an opportunity to practice their communication skills as they adapt to the practices (e.g. collaborative gameplay) associated with the gaming community [19]. Players establish strategic relationships via conversations displayed as chat messages on the screen [8, 9, 16]. Experienced gamers realize successful progression through the virtual world depends on well-formed affiliations that enable players to complete increasingly difficult quests. In-game social interactions require foreign language students to practice their conversational skills in the target language and further develop communicative performance skills while acquiring knowledge of the gaming culture (e.g. planning raids to defeat enemies) [9, 18, 19].

III. LEARNING OUTCOMES CONTRIBUTED TO GAMEPLAY

To examine the two trajectories of learning for ESL students who play EQ2, we compare gameplay activities associated with the game tasks of virtual character progression, combat and management of resources to conversation-based interactions between players. To test our hypotheses, we conducted a between-subjects experimental design to examine if social interactions shorten the learning curve associated with both trajectories of learning for ESL students

who are novice players. We formulate the following hypotheses:

- ESL students who engage in social interactions with other PCs will acquire more English vocabulary than those ESL students who play EQ2 independently.
- ESL students who engage in social interactions with other PCs will accomplish more game tasks in less time than those ESL students who play EQ2 independently.

To test our hypotheses, we conducted a between-subjects experimental design to examine if social interactions shorten the learning curve associated with both trajectories of learning for ESL students who are novice players.

A. *Participants*

Twelve Advanced English as Second Language (ESL) students who were enrolled in a southern liberal arts college and spoke Mandarin Chinese as their native language were randomly assigned to one of two conditions:

- ESL students were instructed to play EQ2 independently and complete the first eight quests.
- ESL students were grouped with Native English Speakers (NES) and instructed to work together as a team to complete the first eight quests.

Participants completed pre- and post-test assessments to evaluate learning outcomes attributed to gameplay experiences. Additionally, eleven of the twelve ESL students completed a pre-game questionnaire that evaluated participants' prior experience playing video games. Thirty-three percent of ESL students indicated that they did not play video games while 33% spend 1 -3 hours per week playing video games, and 25% spend 4 or more hours per week

playing video games. Fifty-eight percent of ESL students had never played a MMORPG before while 33% had experience playing MMORPGs.

B. Methods

To accommodate the learning curve associated with understanding the game objective and maneuvering the game controls, ESL students spent one hour becoming familiar with EQ2. Utilizing the expertise of the ESL instructor, we selected L2 vocabulary words that were not specific to the game (e.g. druids, goblins, and necromancy) and represented college level academic words (e.g. aspire, confrontation, eliminate, hone, influential, valid, etc.) [1, 12, 22]. Each of the twelve L2 vocabulary words was utilized in Non Player Characters’ (NPCs) speech to convey information about quests or displayed as feedback to the player during gameplay. Prior to participation, ESL students completed a pre-test assessment that required ESL participants to use the twelve potential L2 vocabulary words in a sentence demonstrating the students’ prior knowledge. The ESL students who played EQ2 were given the tasks of completing quests 1 – 8 but could choose to complete additional quests. Once both groups of ESL students had completed 4 hours of gameplay, each participant completed two assessments. The first post-test assessment used a recognition task based on gameplay scenarios where ESL participants selected the correct meaning from multiple choice options of ten L2 vocabulary words [1, 4]. The second post-test assessment was a rational “cloze” assessment (fill in the blank) which measured ESL participants’ semantic knowledge of twelve L2 vocabulary words outside the context of gameplay. The ESL students select the appropriate L2 vocabulary word student based upon their understanding of contextual clues located in the text that tell the story about a student enrolled in medical school [1, 11, 12].

C. Data Analysis

The average pre-test score for the 12 ESL students is 8.86 out of 100, indicating prior knowledge of approximately 2.5 vocabulary words out of a total of twelve potential L2

vocabulary words. A one-way Analysis of Variance (ANOVA) of post-test scores for vocabulary words in the context of gameplay produced a significant difference in learning outcomes ($F[1, 11] = 17.78$ for $p < 0.002$ between ESL students who played EQ2 independently versus those who were grouped with NES. ESL students who played EQ2 independently had an average game context post-test score of 25 out of 100 compared to the average post-test score of 65 out of 100 score for ESL students who interacted with NES players. See table 1 and figure 1.

Level	N	Mean	Min	Max
EQ2 Solo	6	25 (SD=13.78)	10	40
EQ2/NES	6	65 (SD=18.71)	40	90

Table 1 Descriptive statistics of ESL students’ post-test scores for L2 vocabulary used in context of gameplay.

We also discovered a significant difference in the post-test scores for outside the context of gameplay assessment. An ANOVA of post-test scores for the rational cloze assessment produced a significant difference in learning outcomes ($F[1, 11] = 24.85$ for $p < 0.001$ between ESL students who played EQ2 independently versus those who were grouped with NES. ESL students who played EQ2 independently had an average post-test score of 2.78 out of 100 while ESL students who interacted with NES players had an average post-score of 38.89 out of 100 for vocabulary acquisition outside the context of gameplay. See table 2 and figure 2.

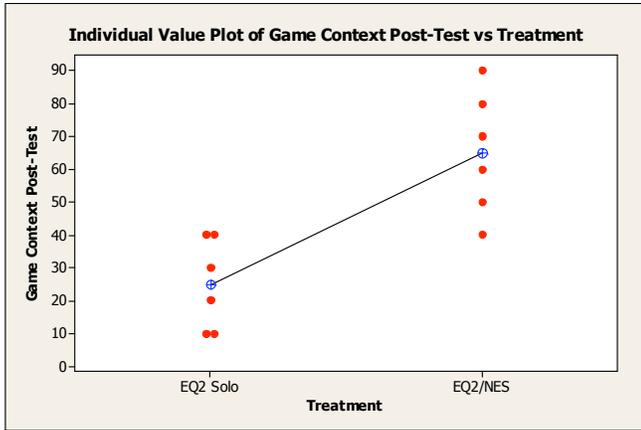


Figure 1 One-way Analysis of Variance of Advanced ESL students’ post-test scores of English vocabulary words in the context of gameplay.

Level	N	Mean	Min	Max
EQ2 Solo	6	2 (SD=1.67)	0	4
EQ2/NES	6	8.33 (SD=1.37)	7	10

Table 2 Descriptive statistics of ESL students’ post-test scores which indicate semantic understanding of L2 vocabulary used outside the context of gameplay.

D. Discussion of Results

Conversations provide the basis for the exchange of information which helps newbies understand the rules of the game [8, 15]. Though the ESL students who played EQ2 independently had the same opportunity to engage in chat-based interactions with other PCs, this group of ESL participants generated less than 100 chat messages. This supports the pedagogical strategy of second language students engaging in conversations with native speakers to develop their communication skills and enrich their vocabulary in the target language [5]. The significant difference of the outside the context of gameplay post-test scores for ESL students who interacted with NES also indicates that the social interactions promoted a deeper understanding of the L2 vocabulary words, enabling transfer of semantic knowledge of

vocabulary words to non-related gameplay experiences.

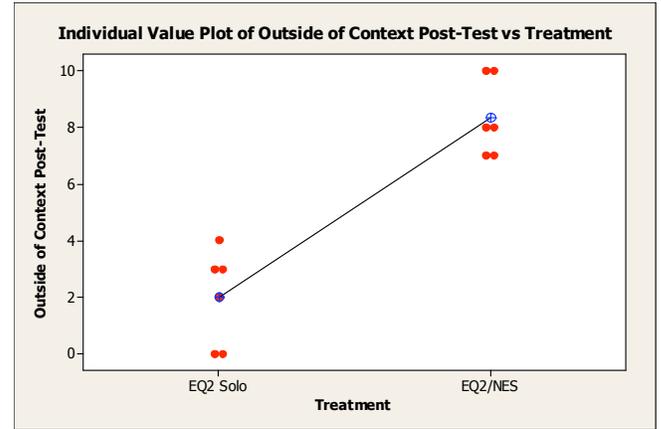


Figure 2 One-way Analysis of Variance of Advanced ESL students’ post-test scores of English vocabulary outside the context of gameplay.

Rankin et al. [12] posit that dominant patterns of chat-based interactions between ESL students and Native English Speakers (NES) aid ESL students’ vocabulary acquisition skills. Two dominant patterns of social interactions that augment SLA in the context of gameplay are: 1. the *question-assert interaction*; and 2. the *question-action directive interaction*. The *question-assertive interaction* indicates that the PC asks questions to get status of other players (e.g. “Are u ready?”) or requests vital information to complete game tasks (e.g. “Tell me where is Sunset Meadows?”). *Assertive statements* demonstrate the PC’s knowledge of EQ2, self or the world. The primary purpose of statements is to make claims. Therefore, if one PC asks a question about equipment and another PC replies “You have to attune your weapon,” this *question-assert interaction* pattern represents an exchange of information or situated learning opportunity that provides a context for developing semantic understanding of L2 vocabulary. Alternatively, if one PC seeks information about a quest from another PC and the PC gives explicit instructions on what to do next or how to complete the quest, then this social interaction is defined as an *Action Directive*. *Action Directives* usually require cooperation or agreement (e.g. “Follow me,” or

“Go talk to that guy over there.”) from another PC, influencing other PCs’ future actions. The act of giving explicit instructions or guidance to another player exemplifies the act of coaching a less experienced player, another situated learning opportunity for vocabulary acquisition.

IV. LEARNING HOW TO COMPLETE GAME TASKS

Remembering the second hypothesis that in-game social interactions reduce the learning curve for understanding and accomplishing game objectives, it is important to identify and evaluate the cognitive process involved in gameplay. To assist with this effort, we utilize Perl scripts to data mine 8 hours of gameplay, more than 35,000 lines of game logs to identify words or key phrases that define a set of game tasks:

- Combat – “You try to crush a lost scout.”
- Casting spells – “You utter an ancient spell of smiting.”
- Gathering or harvesting natural resources – “You gather from the roots.”
- Replenishing Strength – “You eat a ration.”

Newbies are expected to master these game tasks in order to achieve the long term goal of virtual character progression. EQ2 gives feedback throughout the gameplay experience, so that players are aware of areas of improvement and their progress. The category of *feedback* signifies that the PC is in the process of learning how to complete a task (e.g. “You must first select a target before attacking.”) Additionally, we identify a category of achievements, *goals achieved and rewards*, to indicate accomplishment of game tasks:

- Goals achieved – “You gained experience!”

- Rewards – “You loot 7 copper from the corpse.”

The categories of *game tasks* which represent learning opportunities combined with the categories of *feedback* and *achievement* inform the design of visualization tools that provide insights to learning opportunities in MMORPGs.

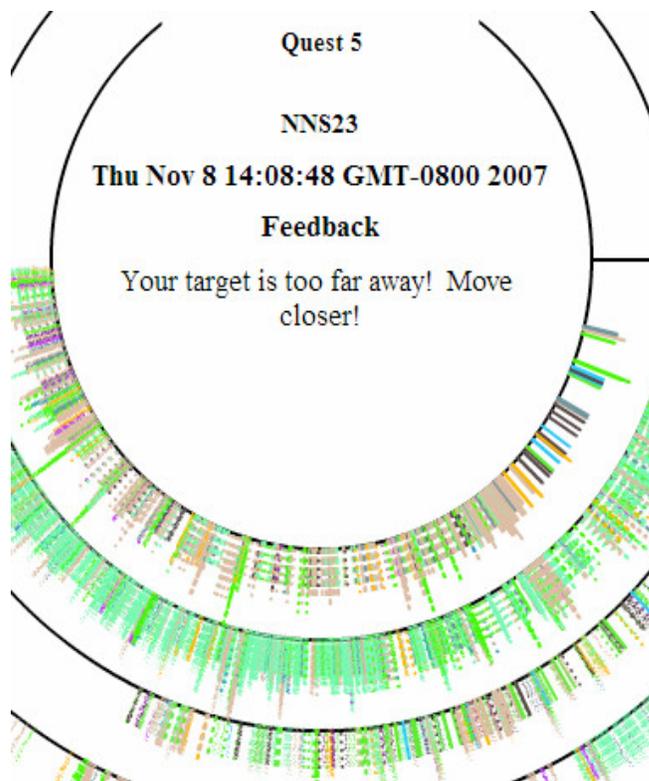


Figure 3 Close-up view of *ClockWerk*© visualization tool which depicts different categories of game tasks and the associated learning processes.

A. *ClockWerk*©: Visual Analysis Tool

Statistical analysis provides one perspective of domain specific learning goals. To gauge learning processes associated with understanding how to play the game, we need tools that offer a different perspective of in-game interactions. Using *Macromedia's*® *Flash* application, we develop *ClockWerk*©, a temporal visualization tool that pictorially depicts game tasks. Rankin et al. [12] first utilized *ClockWerk*© to visually

analyze social interactions between NES player and non-native speaking players. As a natural progression of prior research, we modified *ClockWerk*© to ingest categories of game tasks and previously coded chat-based interactions as text files; *ClockWerk*© visualizes the data in the form of color-coded chat entries representative of gameplay experiences and learning processes associated with mastering game objectives. *ClockWerk*© refers to the clock metaphor that displays second hand ticks in a circular fashion for each chat entry based upon time stamp and color-coded category of game tasks. For example, the color blue denotes *gathering* game activities. Each circle corresponds to the date of a game session. *ClockWerk*© depicts 4 circles for four consecutive days of gameplay. The first and third circles represent the group of ESL students who interacted with NES players for two different game sessions. The second and fourth circles represent ESL students who played EQ2 independently for two game sessions. Refer to Figure 3. When the user hovers over a second hand tick, the chat entry, time stamp, and identity of the speaker are displayed. NNS indicates a non-native speaker. Clockwise movement around the circle shows the sequential order of messages as shown in Figure 3. *ClockWerk*© provides a global view that graphically characterizes learning processes associated with game tasks.

B. Mastering Game Objectives

Utilizing the key phrases indicative of the aforementioned categories and 8 hours of gameplay, visual analysis revealed interesting patterns of interactions that promote learning. We discovered that the hypothesis of ESL students who engage in social interactions with other PCs will accomplish more game tasks in less time than those ESL students who play EQ2 independently did not prove to be true. In fact, ESL students who played EQ2 independently achieved higher levels of experience in less time compared to their ESL peers who engaged in conversations with NES players. See figure 4. As a result, collaborative gameplay utilizes conversation to plan game strategy and coordinate team efforts

which takes more time than an individual player who makes decisions on his/her own.



Figure 4 The ESL students who played EQ2 independently achieved completed more quests and achieved higher levels of experience than their ESL peers who collaborated with NES players.

Additionally, the ESL students who played EQ2 independently accrued looted more corpses during their first game session than their collaborative ESL peers. However, this begs the question of at what cost?

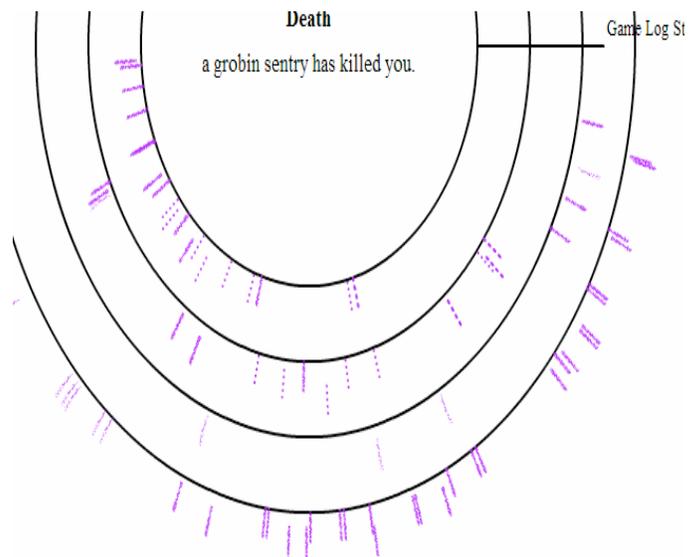


Figure 5 The fourth circle represents ESL students who played EQ2 independently and died more often than their ESL peers who collaborated with NES players.

Figure 5 demonstrates that ESL students who played EQ2 independently (fourth circle) actually died more often despite faster character progression in the second game session than their collaborative ESL peers (third circle), indicating that lack of support or assistance proved temporarily fatal when compared to their peers who spent more time talking to NES players. Keeping in mind the second language vocabulary acquisition attributed to social interactions with NES players, the ESL students who played independently completed more quests and increased in levels of virtual character progression, but failed to maximize the SLA learning opportunities present during gameplay. This confirms that the learning trajectory associated with completing game objectives interfered with learning opportunities for ESL students to increase their SLA. While this is to be expected for a recreational video game not designed for SLA purposes, the significance is that video games designed for educational purposes need to ensure that the learning objectives are intertwined with the game objectives so that players are unable to succeed in gameplay without mastering the learning goals.

Another interesting pattern of game interactions revealed that the majority of ESL students who were grouped with NES players chose avatars that possess physical prowess and fighting capabilities. Thus, visual analysis demonstrated that this group of ESL students spent the majority of their time in combat, becoming competent in defense and attack strategies. In contrast, the group of ESL students who played EQ2 independently selected virtual characters capable of wielding magic or casting spells as a method of fighting. The ESL students who played independently engaged in casting more spells, indicative of learning how to manage the skills of their respective magical avatars. See figure 5. Finally, neither group of ESL students spent much time harvesting natural resources, repairing equipment and clothing or replenishing the strength of their virtual characters, indicating that these tasks become more important with longer periods of gameplay.

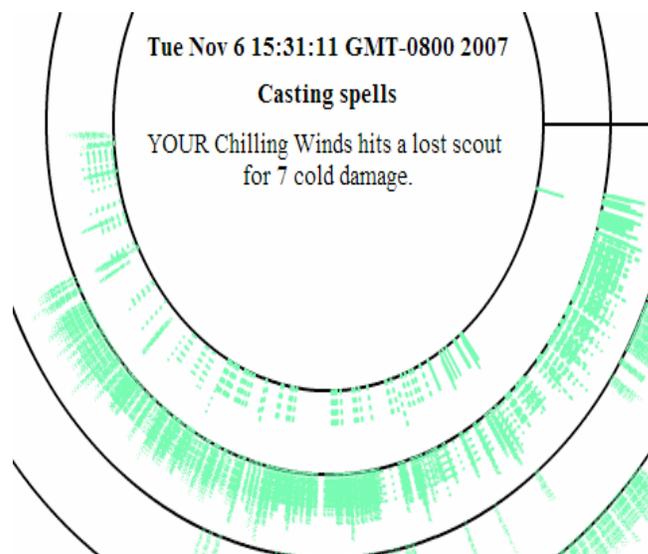


Figure 5 The first circle indicates that ESL students who selected virtual characters with great strength and combat ability spent less time casting spells than the second group of ESL students who chose virtual characters with magical capabilities.

V. CONCLUSION

In summary, we re-purposed the popular MMORPG EverQuest® II (EQ2) as a pedagogical tool for Second Language Acquisition (SLA). Consequently, we identified two different learning trajectories: 1. the cognitive processes associated with SLA, specifically vocabulary acquisition and reading comprehension skills; and 2. the learning processes associated with understanding the objectives of the game and completing game tasks. English as Second Language (ESL) students were randomly assigned to one of two conditions: ESL students who played EQ2 independently and ESL students who were grouped with Native English Speakers (NES). Both groups of students were given the tasks of complete the quests 1 – 8. Statistical analysis reveals that ESL students who participated in collaborative gameplay with their NES achieved higher learning outcomes for the SLA learning trajectory than their independent peers. We then utilize *ClockWerk*© to evaluate the learning trajectory associated with completing game tasks. Both groups of ESL students demonstrated accomplishment of game objectives.

However, the ESL students who played EQ2 achieved higher levels of virtual character progression in less time and accumulated more rewards than their more collaborative peers. These findings suggest that the learning that occurs in recreational video games is quite different from domain-specific learning goals and creates competing goals for ESL students who portray the dual role of student and newbie. Furthermore, we conclude that these two different learning trajectories have serious implications for the design of educational video games, one that requires game objectives to be closely aligned with domain-specific learning goals that facilitate learning along both trajectories.

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