TESL-EJ Teaching English as a Second or Foreign Language
The Electronic Journal for English as a Second Language

Level-up Learning: Video Games in an Online Class

May 2021 – Volume 25, Number 1

David Berry
Kyunghee University, Korea
<baedaebok@hotmail.com>

Abstract

This study considers the impact of playing a video game on EFL students. Specifically, this study looks at how video gameplay impacts students' listening comprehension skills and how it encourages students to develop flow experiences in the classroom. Data about this impact was collected through a quasi-experimental mixed methods research design. The experimental group played a video game while the control group did not. Data was collected about this intervention via three instruments: a pretest and posttest, a flow experience questionnaire, and interviews with participants. This pretest-posttest results analysis showed that both the experimental group and the control group showed significant improvement in their listening comprehension skills. Even though there was no significant difference between the improvements of the two groups, there was a greater increase in listening comprehension skills with the experimental group than with the control group. Also, the questionnaire results revealed that this video gameplay contributed to participants developing flow experiences. This flow experience showed numerous interesting insights about the participants and the learning environment. Finally, this study discusses how video game use can benefit the language-learning situation. It also considers how language-learning situations can be integrated with video gameplay.

Keywords: *DGBL, listening comprehension, video game, flow experience*

Engagement in education

One of the many challenges that education systems have experienced is insufficient student engagement (Hamari, Shernoff, Rowe, Coller, Asbell-Clarke, & Edwards, 2016). One result of this is that many students do not focus or concentrate well in the classroom (Lantz & Stawiski, 2014). . One reason for this is the generational differences between the students and the educational system (Prensky, 2001). These contemporary students have been termed as "digital natives" (Prensky, 2001) or the "gamer generation" (Beck & Wade, 2004). That means that

these generations of students have grown up with social media, video games, and information and computer technologies (ICT) as an everyday part of their lives. These students have thus developed different learning preferences and new mindsets (Oblinger & Oblinger, 2005). Students may be expecting their current classroom and learning experiences to correspond to this level of ICT but they perceive that it does not (Prensky, 2001). Thus, student disengagement is an unfortunate result in many classrooms

One solution that educators have been advocating to address this issue is the use of video games in the classroom (Connolly, Boyle, MacArthur, Hainey, & Boyle, 2012; Mayer, 2016; Prensky, 2001). The use of video games is being heralded to enhance student engagement and motivation in the classroom (Reinhardt and Sykes, 2012). The desire of educators is for students in the classroom to have the same level of motivation and engagement as they do when playing video games. The use of video games in the classroom has been shown to be effective because current students are digital natives and feel more engaged in classrooms that have a game-based context (McGonigal, 2011). They feel more connected to the learning when it includes video games.

Another way to describe how students feel when they play video games is with the concept of flow (Shin, 2006). Essentially, flow means a person is in a state of enjoyment, enthusiasm, and tremendous focus when he is involved in a specific activity (e.g., running, studying, playing a video game). One goal of educators is to somehow have students to experience this flow while they are in the classroom which makes the more effective and rewarding for the student.

The aim of this study is to respond to the following research questions.

Research Question 1: What is the impact of students' playing *SpaceteamESL* on their listening comprehension skills?

Research Question 2: How does playing *SpaceteamESL* contribute to students' developing a flow experience in class?

This paper is significant and contributes to the field of language learning in numerous ways. First, it provides insight and knowledge about flow and video game use among students with an A1 or beginners language proficiency level. The A1 level refers to the Common European Framework of Reference for Languages (CEFR). While there has been some research into video games in the language classroom (Gozcu & Caganaga, 2016), there has not been that much dealing with flow and video game use among A1 students. The issue of motivation and flow is of great importance among students at the A1 level because language learning at this proficiency level is more difficult and de-motivating (Brown & Lee, 2015). Understanding how video games can play the crucial role in encouraging flow experiences among these A1 students is important when planning classes for them. This study's second contribution is that it provides more knowledge and insight into the role of flow in the university setting. This setting has received limited attention (Khan & Pearce, 2015). This setting deserves more attention because language skills become more important as students' start preparing for their career. This study's third contribution is that many studies have dealt with Digital Game-Based Learning (DGBL) applications using desktop computer-based video games such as massive multiplayer online role-playing games (MMORPGs) but not with DGBL applications using mobile games. But games requiring desktop computers lack accessibility and availability in those classrooms that do not have desktop computers. Thus, this study adds value to the literature surrounding the use of mobile games for learning purposes.

Literature Review

Digital Game-Based Learning

Digital technologies have grown in sophistication and use in the 21st century. With these great advancements in digital technologies in the 21st century, the opportunities to leverage this technology for learning has equally grown. Research studies have looked at the successful uses of a variety of digital technologies for learning: online discussion forums for discussing topics (Holenko & Hoić-Božić, 2008), mobile phones for learning vocabulary (Stockwell, 2010), and a classroom management platform called *Classcraft* (Sanchez, Young, & Jouneau-Sion, 2017). Another use of digital technology to enhance learning is with digital game-based learning (DGBL). DGBL means essentially using a video game to promote learning or the "coming together" of interactive entertainment and serious learning (Prensky, 2001). In other words, DGBL is leveraging the medium of entertainment for the purpose of causing learning or cognitive or affective changes in players. Another important definition of DGBL claims that DGBL learning environments should include the following characteristics (Mayer & Johnson, 2010): rules, dynamic reactions to the behaviour of players, suitable challenges that promote players' self-efficacy, and increasing difficulties that are gradual and oriented to the learning outcome. DGBL supports learning by providing a medium for students to be engaged in a competitive activity (Erhel & Jamet, 2013). This competitive activity (i.e., the gameplay of the video game) has educational goals that promote the learning of knowledge or skills. For the video game to do this effectively and promote learning, it must balance gaming elements and learning (Nussbaum & Beserra, 2014). Many research studies have shown DGBL has successfully been implemented in 21st century classrooms (e.g., military training (Garris & Ahlers, 2001), high school science (Harker-Schuch, Mills, Lade, Colvin, 2020), kindergarten classes (Din & Calao, 2001), nursing (de Souza, & Cogo, 2017), agricultural science (Klit, Pederson & Stege, 2018), and physical education (Casey, Goodyear & Armour, 2016).

There are many advantages for using DGBL in the classroom or other learning situations. First, DGBL is a new literacy that promotes compelling learning in cultural literacy dimensions (Sanford & Madill 2007). This means that game players are presented with many beneficial aspects of life such as values, rules, and standards. Second, video games externalize or mirror how people think (Gee, 2007). Having students recognize the process of thinking is of great benefit for developing their language skills. They would be able to develop their language learning thinking processes. Third, video games promote greater understanding and the ability to retain new information more effectively (Prensky, 2001). The greater understanding and ability are achieved because DGBL encourages players to use their multiple intelligences that promote these abilities. Fourth, video games encourage collaboration that benefits learning (Gee, 2007). The indicated collaboration is done by clearly demonstrating to students that good collaboration leads to engaged thinking and learning. Fifth, DGBL empowers students to be more involved in their own language learning by personalizing their learning (Newcombe & Brick, 2017). Sixth, the classroom level DGBL facilitates the instructor to present and practice language in different and more creative modes (Reinders & White, 2009). Finally, using video games in the classroom causes engagement in the learning experience. This engagement happens with DGBL because the learning is reformatted into a gaming context (Prensky, 2001). Thus, it can be commonly observed that video game players enjoy playing video games to the extent that they are often completely engrossed and engaged in playing them. Video gamers say they have a positive experience when playing video games (Godwin-Jones, 2014).

The demographic data shows the widespread popularity of video games. In the United States alone, gamers made $43.4 billion of video game purchases in 2019 (Entertainment Software Association, 2019). There are 2.2 billion active gamers in the world and 28.9 million of them are playing in South Korea – 53 percent of the population (Peterson, 2012). This makes South Korea the fourth largest video game market globally (McDonald, 2018). In the United States again, mobile phones were the most common device for playing video games in 2019 (Entertainment Software Association 2019). In fact, playing video games has become such a common part of the social fabric in South Korea that even a prestigious university has declared it as a major (Sorokanich, 2014). More specifically, playing video games among university students has become equally popular. In addition, 40% of the population is gamers who are usually 20-34 years old and almost half are women (Johnson, Adams, Cummins, Estrada, Freeman, & Ludgate, 2013).

Choosing the suitable video game for a classroom is very important. However, what is also of great importance when choosing video games for the language classroom is not just the game itself but how it is implemented into the course and individual classes (Goodwin-Jones, 2014). If a suitable game is implemented poorly, then the benefits from that game are minimized or missed. Thus, it is important to choose the appropriate game and implement it in a suitable manner.

SpaceteamESL was chosen as the video game to be used as the primary intervention instrument for this study for many reasons. First, *SpaceteamESL* can be downloaded for free and played on mobile phones and tablets (Smith, 2012). These attributes translate into much greater accessibility for the game. More students are willing to play a video game that can be downloaded for free. Second, *SpaceteamESL* is a mobile game. Since the game is available on mobile means that students can play this game anywhere and at any time (Ogata & Yano, 2003). They are not constrained by needing a desktop computer to play the game which means that the students can move their learning environment to any location and at any time (Ogata & Yano, 2003). A third reason is *SpaceteamESL* causes players to develop feelings of comfort (Grimshaw and Cardoso, 2018). Fourthly, *SpaceteamESL* was chosen because the difficulty level or challenge of the game was suitable for the participants in the current study. The participants would be challenged but not overwhelmed by the required gameplay when playing this game since *SpaceteamESL* can be customized to match the skill-level of the students. The final reason for selection was that the gameplay fulfilled the study's needs. Other studies have demonstrated that this game fulfills the requirements of a 'fluency development activity' (Grimshaw & Cardoso, 2018). That is, *SpaceteamESL* promotes the development of oral and listening fluency which this study intends to analyze.

Flow Experiences

It can be commonly observed that video game players greatly enjoy playing video games. Video gamers say they have a positive experience when playing video games (Godwin-Jones, 2014). A popular construct to explain this positive experience is the concept of flow experience (Procci, Singer, Levy & Bowers, 2012). A flow experience refers to a euphoric feeling of happiness and enjoyment while doing an activity. The concept of flow experience was first developed to explain and understand peoples' feeling of happiness when they were engaged in activities (Csikszentmihalyi, 2000). This sense of euphoria happens when the person is totally engrossed and is completely absorbed in a particular activity that they thoroughly enjoy. Because they are so absorbed in the activity, they have tremendous concentration and focus.

They are not aware of other matters such as time, the environment around them, or even themselves, which become unnoticed (Csikszentmihalyi, 1990). In fact, the activity is so absorbing and rewarding that the joy from doing the activity is the reward in itself — outweighing an external reward. In fact, the people felt so happy to be engaged in a particular activity that they felt harmony with the activities. Having students experiencing this flow is quite desirable in a learning situation (Wang & Hsu, 2014). These flow experiences would greatly facilitate learning. Many researchers have studied flow experiences in different contexts and have made different observations (e.g., McQuillan & Conde, 1996; Schiefele & Csikszentmihalyi, 1995; Webster, Trevino, & Ryan, 1993). Some of these contexts are dancing, doing math, running, Internet surfing, and surgery. These studies showed that flow is a complex mix of factors or dimensions.

This is a brief description of the components of a flow experience. A flow experience could be divided into two clusters of dimensions (Csikszentmihalyi, 1975). The first cluster are the pre-conditions that must exist for a flow experience to develop. The first precondition is a balance between skill and challenge. This is when there is a perceived balance between the skills of the student and the challenge posed by the activity. Challenge is the skills and knowledge that the activity requires the student to have to succeed at the game. For students to expand their skills to reach the challenging goal — the skill and challenge must be somewhat balanced or quite close (Shernoff & Csikszentmihalyi, 2009). In other words, the game cannot be too easy or too difficult for the student to play successfully. The second precondition is the activity must have clear and known goals, objectives, or reasons for playing (Csikszentmihalyi & Csikszentmihalyi, 1988). These goals must be clearly communicated to the player. The third precondition is the activity needs to provide the student with continuous and immediate feedback — not delayed or summary feedback. This feedback should inform the student about their status in the activity (Chen, Wigand, & Nilan, 1999).

The second cluster of dimensions describes the actual characteristics of a flow experience that a person should be exhibiting when he is experiencing flow. The first characteristic is a high degree of concentration. He is completely absorbed by the activity or game. Any actions done by the individual are almost automatic and done without thinking. Secondly, the individual has a sense of control over the activity. Lastly, the student needs to be experiencing an autotelic state which means he feels happy and is greatly enjoying the activity.

Methodology

Research design

During the present quasi-experimental mixed methods study, the researcher intervened in seven intact EFL classes of Korean college students. The researcher was also the instructor of all these classes. Four of these classes formed the experimental group (EG) and three of these classes formed the control group (CG). The intervention was EG participants playing a video game for 20 minutes at the end of each class. CG participants participated in parallel but non-DGBL language learning activities during the same 20 minutes. The researcher wanted to identify the impact of the DGBL intervention on the participants' listening comprehension skills and flow experiences. The independent variable was the type of intervention: either participating in playing a video game or a non-DGBL learning activity. The dependent variables are the participants' listening comprehension skills and their flow experiences.

Participants

Participants were 18-21-year-old Korean college students studying in a mandatory 15-week "College English" course in which EFL communications skills were taught (i.e., speaking and listening). The university was in Suwon, South Korea. The students were from vocational departments.

During the time of the previously mentioned study, COVD-19 restrictions were in force at the university for students and faculty. The result of these restrictions was that students and their respective professors could not meet in person for the regularly held weekly classes during the entire semester. In lieu of these face-to-face classes, classes were held using video conferencing technology.

At the beginning of this study there were 94 participants in this study. Of the 94 participants, 48 were male (52%) and 46 were female (48%). These 94 participants were students who met in one of seven pre-existing intact classes. Due to participant mortality, the number of participants dropped from 94 at the course-start to 61 at the course-end (representing a 35% response rate decrease).

All participants were members of one of these seven intact classes. The classes were evenly distributed between EG and CG so that students from both groups would largely share similar characteristics and context (e.g., the even distribution of morning classes and afternoon classes between EG and CG). See Table 1 for details about the participants in this study.

Table 1 Background of participants.

	Students present at semester start (Response Rate)			Students fully participating at semester end (Response Rate)		
	EG	CG	Total	EG	CG	Total
Major						
Social welfare	15	0	15	10	0	10
Hotel baking	22	22	44	19	18	37
Distribution management	0	10	10	0	7	7
Heavy machine operators	17	8	25	4	5	9
Total	**54**	**40**	**94 (100%)**	**33**	**28**	**61 (65%)**
Gender						
Male	21	27	48	15	13	28
Female	33	13	46	18	15	33
Total	**54**	**40**	**94 (100%)**	**33**	**28**	**61(65%)**

Materials and instruments

SpaceteamESL. In 2015*, SpaceteamESL*, this study's intervention instrument, was developed by David Waddington and Walcir Cardoso (from Concordia University, Canada) with help from the independent game designer Henry Smith (Grimshaw & Cardoso, 2018; W. Cardoso,

personal communication, January 18, 2021). This free-to-play multiplayer cooperative shouting mobile game can be played by two to six players. To define these terms, a multiplayer game is any game where several players need to play simultaneously. It is not possible for single players to play. A cooperative game is a game where players must cooperate to win the game. Cooperative games are in contrast with competitive games where players win by gaining more points (or other awards) than the other players. A shouting game is that kind of game where shouting is an instrumental part of the gameplay and is needed to succeed at the game. The gameplay of *SpaceteamESL* is unique because it combines all these features into one game.

When playing *SpaceteamESL*, the mobile phone screen is divided into thirds. The bottom third of the screen is a control panel with four to six named controls which players must manipulate when they hear commands to do so (e.g., push, rotate, turn, switch). The middle third half of the screen is the horizontal command line bar. This is where commands for the players to follow are displayed for a predetermined period of time. The three predetermined periods of time (i.e., 15 seconds for *Very Slow*, 10 seconds for *Slow*, and 5 seconds for *Normal*) are set ahead of time by the instructor. Between the command line and the control panel is a green line that moves to the left as the period of time runs out. The top third of the game provides feedback about the game spaceship status. See Figure 1 for the screenshots of the game being played.

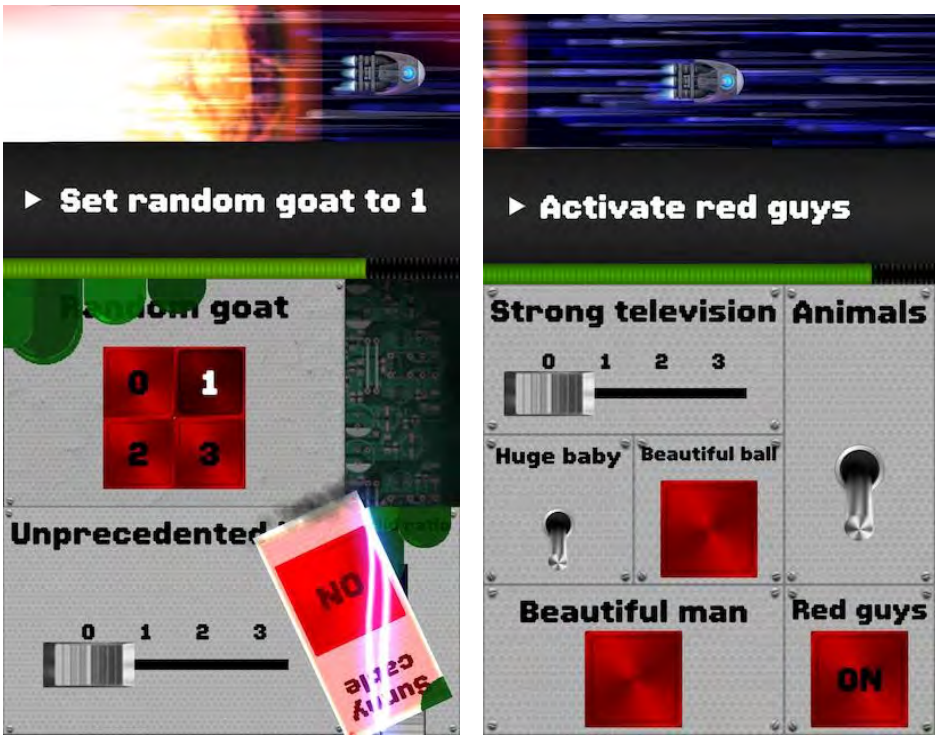

Figure 1. Screenshots of SpaceteamESL's user interface: mobile phone screen showing instrument panel and command line for player 1 and player 2

In this fun, challenging, and educational gameplay; players are working together to successfully fly a spaceship and prevent it from crashing. They do this by each player quickly following the commands shouted by another player and manipulating their control panel appropriately. The twist of the game is that the instructions are randomly sent to different players' mobile phones. This means the instructions that are sent to one player's mobile phone screen are usually meant for other players to follow. Each player needs to multi-task or do two tasks simultaneously:

quickly and clearly say his command out loud and listen for commands from other players about his control panel. Players must listen carefully for other players' commands that mention instruments from his control panel. This type of gameplay thus encourages students to communicate by listening and speaking clearly.

These commands and control's names are generated from wordlists. The commands are variations of either pattern one (verb phrase + "control's name") (e.g., "Switch on bird") or pattern two (verb phrase + "control's name" + prepositional phrase + noun) (e.g., "Set blue program to 1"). The game's wordlists can either be one of the five default wordlists or be customized by the instructor in the game's website. The five fixed default wordlists correspond to the five levels of difficulty in the game (i.e., Level 1, 2, 3, 4, 5) where Level 1 includes the 1000 most frequently used words in the English language, level 2 the top 2000, and so on for all five levels. These wordlists are based on the Corpus of Contemporary American English (COCA) wordlists (Davies, 2008). This study used customized wordlists based on the course curriculum.

Pretest-posttest. The pretest and posttest design compared the improvement in listening comprehension between EG and CG participants during the course. Both the pretest and posttest were from the Listening Comprehension section of a commercially available TOEIC preparation book (Lougheed & Lougheed, 2007). The TOEIC has been shown to have a high level of reliability and validity (Sewell, 2005). To complete this listening test, participants logged into the college's LMS and accessed the listening test. They had 20 minutes to complete this test. The pretest and posttest used similar test items from this same pool of test items. The reason for doing so is to ensure the comparability of the pretest and posttest. The test's three sections included 11 photograph-viewing items, 6 question-response items, and 3 short conversations.

Interviews. Semi-structured interviews were also conducted with eight carefully chosen EG participants (based on their questionnaire results) to help understand their views about playing *SpaceteamESL*. The interview asked the nine basic interview questions and any relevant follow-up questions. It was also conducted in the native language of the students (i.e., Korean) with the help of a qualified bilingual translator.

Table 2. Interview questions from the question pool.

1.	How did playing *SpaceteamESL* help your English learning?
2.	Why is playing *SpaceteamESL* motivating to learn English?
3.	What was most enjoyable about playing *SpaceteamESL*?
4.	What was most difficult when playing *SpaceteamESL*?
5.	How did you feel when your partner said a command from the game?
6.	How often did you succeed in following your partner's command before the time ran out?
7.	Why did you feel good when you were playing *SpaceteamESL*?
8.	How did interacting in a team affect your gameplay?
9.	What strategy or method did you use to win at playing *SpaceteamESL*?

Flow Questionnaire. The basic flow questionnaire used in this study to measure the participants' flow experience was based on a previous questionnaire used to also measure university students' classroom flow experience (Buil, et al., 2019). This study's questionnaire was designed to gather participants' responses to 26 statements along a 5-point Likert scale (i.e., extremely disagree, disagree, don't agree or disagree, agree, extremely agree). The 26 were grouped into the flow experience's six dimensions. Out of this basic questionnaire was created two questionnaires – one for EG participants and one for CG participants. All 26 statements and 5 Likert scale labels were translated into the native language of the participants (i.e., Korean) to ensure an optimal level of understanding of the statements by participants. The questionnaires were verified for content validity by language education experts. These experts concluded that each of the 26 statements in the questionnaire clearly communicated the intended dimension.

Procedure

This quasi-experimental mixed methods study investigated how playing a video game impacted the listening comprehension skills and flow experiences of 94 participants. Throughout the 15-week semester, all students participated in weekly 95-minute classes. These 95-minute classes were divided into Session 1 and Session 2. Session 1 was asynchronous and required students to watch an instructor-uploaded 75-minute video lecture on the college's learning management system (LMS). These weekly video lectures were the main teaching vehicle that the instructor used to teach the course curriculum. Session 2 was a 20-minute synchronous video conferencing session. During Session 2, the instructor led students to do various learning activities.

This general schedule of research activities was followed during this semester. In Week 2 the 94 participants in the college's LMS completed a pretest. In Week 3 the EG group and the CG group were created from the seven intact classes. Four intact classes were assigned to the EG group and three were assigned to the CG group. The intervention was done during Session 2 for eight occasions -- starting in week four and ending in week twelve. During Session 2 EG participants played *SpaceteamESL* in teams of two or more participants. Each week's gameplay used the customized wordlist taught in the Session 1 video lecture. The nature of the gameplay used the wordlists in the context of primarily listening comprehension practice. Participants needed to listen for the commands that were related to their instrument panel and push (or somehow manipulate) the matching instrument. In contrast, CG participants' Session 2 activities were non-DGBL group activities that practiced the same language skills as EG participants – primarily listening comprehension. They participated in teams where their listening comprehension activities were used. Both the EG and CG activities used the same wordlist and language skills – specifically listening comprehension skills. In Week 13 a posttest was completed via the college's LMS with a response rate of 65%. In Week 14, the flow questionnaire was completed on the college's LMS with a response rate of 85%. The interviews followed this in week 15 after the questionnaire was briefly analyzed. Interviews were held with 8 EG participants - chosen based on questionnaire results and receptiveness. They were held with a Korean translator through the video conferencing system.

The high response rate of both research instruments (i.e., 65% and 85%) could be attributed to the fact that all the participants were contacted numerous times about the instrument. Also, the nature of the intervention and desire to stay connected may have encouraged participants to complete both research instruments. The response rate was at a reasonable level and was not

problematic in this study (Armstrong & Overton, 1977). See Table 1 for more details.

Data Analysis

To generate these calculations, both the software package *G*power 3* (Faul, Erdfelder, Lang, & Buchner, 2007) and *Real Statistics Resource Pack* (Release 7.2) (Zaiontz, 2020) were used. They were both used to verify the accuracy of the statistics. First, to respond to research question 1, the pretest and posttest data were analyzed. Descriptive statistics of the pretest and posttest data were generated. This would help in determining if test scores followed a normal distribution. Once normality was confirmed, *t*-tests were applied to the data to determine significance. Several *t*-tests calculations were performed on the test data. The first calculation was an independent-samples *t*-test to find if there was homogeneity (or any significant differences) between CG participant pretests and EG participant pretests. A second calculation was two separate dependent samples *t*-tests to analyze the pretest and posttest score differences of EG participants and then of CG participants. The *t*-test would reveal if any differences between the scores were significant.

Second, data from both the EG flow questionnaire and CG flow questionnaire was analyzed to respond to research question two. The flow questionnaire's internal consistency was first verified with a Cronbach's coefficient alpha. Also, a Wave Analysis was conducted to detect any response bias. Next, the descriptive statistics of the data was analyzed to determine if the data was normally distributed. Finally, significance testing was applied to data from the EG questionnaire and the CG questionnaire in the eight dimensions of the questionnaire. This would help determine which dimensions played a greater role in developing a flow experience in the participants. The resulting *p*-values were analyzed to determine the levels of significance between the dimensions.

Third, the interview data was analyzed to shed light on EG participants' views and opinions about playing *SpaceteamESL* and DGBL in general. Records of these interviews were generated during the interviews. The records of the semi-structured interviews were analyzed and coded. They were coded by looking for surprising or interesting insights. The next step was to find patterns or similarities between these coded instances. These coded insights were combined into categories or themes. This was the procedure that was recommended by other researchers (e.g., Bakker & Wicherts, 2014).

Findings and Discussion

The two research questions were addressed by looking at the findings from the pretest-posttests and the questionnaire.

To answer the first research question, the pretest and posttest data was first analyzed to verify its normality. All tests revealed the test data followed a normal distribution. The median and mean of the four sets of test data were found to have essentially the same value. Also, the skewness and kurtosis values were between the values of -2 and +2 (George & Mallery, 2010). Also, the results of the Shapiro-Wilk Test and the d'Agostino-Pearson Test returned *p*-values of greater than $\alpha=0.05$. See Table 3 for the results of these normality tests.

Table 3. The normality of the data.

	Pre-Test		Post-Test	
	EG	***CG***	***EG***	***CG***
N	33	28	33	28
Mean	13.03	13.59	15.88	16
Median	13.00	14.00	16	14
SD	3.86	4.45	4.05	4.65
Skewness	-0.104	0.040	-0.068	0.158
Kurtosis	-0.631	-0.637	-0.348	-0.641
D'Agostino-Pearson	0.670	0.753	0.944	0.689
Shapiro-Wilk	0.590	0.820	0.902	0.303

Once normality was confirmed, significance testing was applied to the data using *t*-tests. The pair of EG and CG pretests were compared using independent-samples one-tailed *t*-tests to check the participants' pre-intervention homogeneity. This *t*-test revealed homogeneity among the CG and EG participants (p=.34 with α=0.05), so there were insignificant differences between the two groups. In fact, the small effect size also confirms little difference between these two samples. See Table 4 for more details.

Table 4. Results of the independent samples t-test on EG and CG pretests.

	N	M	SD	*t-crit*	df	*p*	*Effect r*
EG	33	13.03	3.86	.67	59	.34	0.055
CG	28	13.59	4.45				

Second, the EG pretest and posttest scores were compared. This revealed a performance increase from pretest scores (M=13.03, SD=3.86) to the posttest scores (M=15.88, SD=4.05). To determine if this increase was significant, a paired-sample one-tailed *t*-test was applied to this increase. The test results showed that this increase was significant ($p<.01$ with α=0.05). Indeed, a high effect size also confirms the increase was significant. This reveals the significant improvement that the treatment made on EG participants. The treatment of playing *SpaceteamESL* significantly improved the listening comprehension test scores of EG participants.

Table 5. Results of the paired-sample t-tests.

Group	Test	Mean (SD)	*T*	Df	*p*	*Effect r*	*Cohen's d*
EG (*n*=33)	Pre-	13.03 (3.86)	1.69	32	0.00*	0.894	1.971
	Post-	15.88 (4.05)					
CG (*n*=28)	Pre-	13.59 (4.45)	1.7	27	0.0**	0.896	1.977
	Post-	16.00 (4.65)					

*p<.001 **p<.01

Interestingly, CG participants' test scores also increased from the pretest (M=13.59, SD=4.45) to the posttest (M=16.00, SD=4.65). A paired-samples one-tailed *t*-test on CG pretest and posttest scores showed that this improvement was significant. This is also confirmed with a large effect size -- shown by a high Cohen's *d* and effect *r*. Table 5 reveals more details. Thus, participants from both groups experienced significant improvement in their posttest scores. The almost identical effect sizes of both CG and EG participants confirm they both increased significantly. However, even though both groups improved significantly, the EG test scores increased more. This shows that the improvement of EG participants was greater than CG participants.

In brief, this clearly shows that playing *SpaceteamESL* caused a positive impact on students' listening comprehension skills. Those students who played *SpaceteamESL* (i.e., EG participants) reached a higher achievement in listening comprehension skills than those students who did not (i.e., CG participants). This responds positively to research question one.

Research question two was responded to by the flow questionnaire and the interviews.

All participants completed either the EG or CG questionnaire online. The response rate for completing the flow questionnaires was quite adequate at 80 out of 94 participants -- 49 from EG and 31 from CG. This represented a questionnaire response rate (non-respondent rate) of 94% (6%) and 74% (26%) for EG and CG, respectively. Because of these non-respondent rates, a response bias could have entered the data and distorted the overall results. To identify any potential response bias, a wave analysis was conducted, and no great difference was identified in the questionnaire responses between early, middle, and late submissions.

To check the questionnaires' reliability, the questionnaires' Cronbach's Alpha was calculated and found to be 0.936 and 0.947 for the EG questionnaire and CG questionnaire, respectively. Both questionnaires exceeded the level of 0.8 that has been considered a threshold of reliability for research instruments of this nature (Hulin, Netemeyer, & Cudeck, 2001), Thus, both questionnaires were considered to have great consistency and reliability — more than sufficient for this study.

Next, the Shapiro-Wilk test was conducted on the questionnaire data to determine if it was normally distributed. Unfortunately, not all the data was normally distributed. Because normality of all the data could not be guaranteed, *t*-tests could not be used. Instead of the *t*-test, the Mann-Whitney U test was employed because it can be used for non-normal ordinal data that compares significance between two independent samples. Also, it reduces the impact of

outliers and other aspects of data that may be present when the data is not definitely normal (Sheskin, 2011; Bakker & Wicherts, 2014).

Questionnaire data was generated from respondents who rated the 26 statements along the 5-point Likert scale. These 26 statements were collapsed into six dimensions of flow. The resulting data for the six dimensions was analyzed and descriptive statistics generated. These descriptive statistics for the six dimensions of flow were tabulated (see Table 9). The means of all the dimensions of flow in the questionnaire were quite high. This means that the synchronous Session 2 activities (either EG playing the video game or CG doing a non-DGBL activity) contributed to developing flow experiences among the participants. This was encouraging that both DGBL and non-DGBL activities contribute to all the dimensions that go into developing the flow experiences of the participants.

Next, the findings that showed the overall flow construct of both EG and CG were analyzed. This construct is a summation or combination of all six dimensions of flow. This can be seen in Table 6 with the Flow Construct. EG participants had a greater flow experience (M=3.111, SD=0.944) than CG participants (M=3.003, SD=0.799). This clearly demonstrates that EG participants playing *SpaceteamESL* had a greater flow experience than CG participants, but this difference was not significant – as shown by applying the Mann-Whitney U test (p=.129 with α=0.05). Nevertheless, the gameplay of *SpaceteamESL* made a greater contribution to EG participants' flow experience than with CG participants even if it was not a significantly greater contribution. This confirms previous research where learners using DGBL over non-DGBL activities caused greater flow to be present (Choi & Baek, 2011).

The specific flow dimensions of CG participants and EG participants were also compared using Mann-Whitney U tests. As can be seen in Table 6, only the flow dimensions of "balance of skills and challenge" and "clear goals" for EG participants showed to be significantly higher than for CG participants. These two dimensions of flow are two preconditions of flow. Their presence is necessary for a flow experience to exist. The fact that they are significantly more present with EG participants (participating in DGBL) shows that DGBL activities contributed significantly more to having a flow experience. These two preconditions may exist more when engaged in DGBL because a digital game may be more specifically designed to provide a challenge that adopts to the skill level of the player. A computer can change the challenge level of a game. But a traditional non-DGBL activity cannot easily adjust or differentiate the challenge inherent in the activity. To differentiate an activity means to change it somehow to accommodate the needs of the user. This differentiating or adjusting by a game ensures that there is a closer balance between skill and challenge. This is the case with *SpaceteamESL* where it can adapt to the level of the player. This is also the case with "clear goals". A digital game can more clearly and easily show the player the goals of the game. This may not be as easy to do with non-DGBL activities. *SpaceteamESL* shows the game's goal throughout the game in the user interface.

Table 6. Questionnaire results about flow experiences of participants, (n(EG)=49 and n(CG)=31)

Dimensions of flow		Mean (SD)	*p*-value	*z*-value
Balance of skills and challenge	EG	2.980 (0.911)	0.018	2.11
	CG	2.669 (0.843)		
Clear goals	EG	3.225 (0.935)	0.043	1.75
	CG	2.914 (0.761)		
Feedback	EG	3.020 (0.861)	0.249	0.707
	CG	2.919 (0.753)		
Concentration	EG	3.204 (1.002)	0.500	0
	CG	3.202 (0.786)		
Sense of control	EG	3.143 (0.929)	0.377	0.331
	CG	3.204 (0.774)		
Autotelic	EG	3.090 (0.960)	0.453	0.121
	CG	3.073(0.723)		
Flow Construct	EG	3.111 (0.944)	0.129	1.13
	CG	3.003(0.799)		

For CG participants, the two biggest contributors to the flow experience were a *sense of control* (M=3.204 SD=0.774) and *concentration* (M=3.202 SD=0.786). For CG participants doing non-DGBL online activities, an activity that encourages *concentration* and a *sense of control* most contributed to their flow experience. In contrast, the dimension that played the least role in developing a flow experience with CG is a *balance of skills and challenge* in the activity (M=2.669 SD=0.843). This could mean that the major criteria when choosing (or designing) online classroom activities for the EFL classroom is an activity with clear goals and a sense of control.

For EG participants, the two dimensions that contributed most to the flow experience were the dimensions of clear goals (M=3.225 SD=0.935) and concentration (M=3.204, SD=1.002). The importance of concentration was equally important for CG participants. This reflects the importance of concentrating on an activity to encourage a flow experience to develop. Unlike CG prioritizing a sense of control as the most important flow dimension, EG designated setting clear goals as playing the greatest role in the flow experience. Participants felt that clear goals played a bigger role in developing flow experience when participating in a DGBL activity. This contrasted with CG participants where clear goals played the second least important contributor to flow experience. This may reflect the emphasis that video games put on making goals clear

at the beginning of the game. Like CG participants, concentration was the second highest contributor to developing a flow experience for EG participants. For both CG and EG participants the dimension of a balance of skills and challenge played the least role in developing a flow experience.

Another interesting insight can be gleaned about EG participants. Individual differences of the student (e.g., concentrating (M=3.204, SD=1.002), having clear goals (M=3.220, SD=0.935), and having a sense of control (M=3.143, SD= 0.929)) contributed more than the dimensions related to instruction (e.g., balance of skill and challenge (M=2.980, SD=0.991)). In fact, the dimension of balance of skills and challenge play the smallest role for both EG and CG participants. This reveals that the individual differences of the students play a greater role in developing flow experiences than does the instruction itself. This finding corresponds with other similar studies looking at the flow experiences of university students (Shin, 2006).

The semi-structured interviews with the eight EG participants revealed some things in common. All participants' felt playing *SpaceteamESL* was a positive experience and contributed to their learning. This was about the first question regarding how the game helped their learning. Participants felt that by playing *SpaceteamESL* and having to manipulate the game buttons with the new words on them, they were pushed to learn new words. Some students elaborated further that the game provided practice of using the new course words. The meaning or use of words was not presented in the game but that the game made them more familiar and comfortable with new words. Also, some participants felt that the gameplay helped them improve their ability to orally communicate with others. This was because the gameplay required all players to quickly communicate with others. This may be one reason why the EG participants' *t*-tests revealed significant improvement of EG participants' listening comprehension skills during the intervention. Because EG participants viewed the required listening as fun, they became more engaged in listening and their listening skills improved. Also, the challenge of the game made the game fun. This reflects past studies in students perceiving gameplay as causing curiosity (Warschauer & Healey, 1998).

In terms of question two, which asked how or why, *SpaceteamESL* motivated players, several participants felt the game created a desire and curiosity to study English more. In fact, they felt the game was a fun way to learn because it was not a traditional way of learning. Other students said that giving orders in the game created curiosity and fun. They felt the game did this by presenting them with sentences that they had to speak quickly within a time limit. This did not directly relate to the listening comprehension skills of the students. However, improved oral skills might indirectly contribute to their improved listening comprehension skills. This would thereby explain the result of EG participants' improved listening comprehension skills.

In answering questions three and four about what was most enjoyable and most difficult in the game, participants had varied answers. The game's highlight for many participants was playing and learning together. This matches other studies that show learners perceive closeness to others when involved in a meaningful classroom activity together (Greitemeyer & Cox, 2013). One participant voiced his dislike for traditional ways of learning by himself. The game offered a way to learn new words and practice speaking together even if they were not physically together. In contrast, several participants felt the time limit to respond to commands was most difficult.

Question five dealt with how players felt when one player uttered a command that another player needed to respond to in time (during the gameplay). Participants said it made them feel nervous to respond in time. This caused some participants to become frustrated when the time limit ended.

The final question asked about how game-players succeeded at playing the game. There were mixed responses to this. Some participants tried to create a listening and speaking system so that each of them took systematic turns in saying their command. But some participants said this system did not work because they never reached higher levels. Other participants claimed that they reached higher game levels by using their intuition about when to speak. They "felt" that at certain moments during the gameplay it was better for them to say their command. This strategy resulted in reaching higher levels in the game.

Implications and limitations

The purpose of this study was to empirically investigate the impact of differing learning environments on the development of learners' listening comprehension skills and flow experiences. One learning environment involved DGBL where participants played *SpaceteamESL* for 20-minutes in weekly classes. The other involved a non-DGBL activity. The numerous findings from this investigation were insightful.

The first insight was about how to integrate *SpaceteamESL* into the curriculum of the course. In this study, *SpaceteamESL* was used as a way for students to practice (for 20 minutes at class-end) the language skills they had learned earlier in the class that day. This was found to be an effective use of classroom time to enhance students' listening comprehension skills. Alternatively, the students could play the game as a 20-minute warm-up that had been shown to also enhance language skills but not significantly (Grimshaw & Cardoso, 2018). Since the game has been shown to develop a flow experience, this initial gameplay may encourage students to enter a flow experience. Also, the game is a pre-prepared, ready-made game for listening (and oral) practice that the teacher does not need to develop. This makes it ideal for any learning environment such as where listening comprehension or even oral skills are taught.

A second insight is that EG participants playing *SpaceteamESL* made significant improvements in their listening comprehension skills. Even though both groups (CG and EG) made significant improvements in their skills, the skill improvement was greater for EG participants. These results revealed that *SpaceteamESL* is an effective method to enhance listening comprehension skills among EFL students. To enhance student achievement in their listening skills (and perhaps in other language skills also), these results suggested instructors consider integrating DGBL activities into their instruction. Facilitating students to learn or enhance their listening comprehension skills is a highly complex endeavor that involves many different sub-skills. One sub-skill that is greatly used in *SpaceteamESL*'s gameplay is the listening for specific or important detail. This listening sub-skill is important for students' effective listening comprehension (Barta, 2010). Instructors can integrate *SpaceteamESL* into lessons where this sub-skill is taught or plays an important role.

The third insight was that participants in both learning environments did experience flow as they were engaged in their related activity. But the flow experience of the learners in the DGBL environment was greater and more profound. This result should be gratifying because the DGBL research community has shown great interest in flow experiences and how they relate to game-playing (Chen, 2007). Of the six dimensions of flow experiences, certain dimensions

contributed more to the learners' flow experience than others. For learners in the DGBL learning environment, the dimensions of concentration and clear goals were the biggest contributors. In the other non-DGBL activity learning environment the biggest contributor was the dimensions of concentration but also a sense of control. These findings can be interpreted in different ways by different people. For classroom practitioners, it is imperative that all classroom activities (especially the DGBL activities) encourage concentration and focus. The instructor needs to have students engaged in concentration-enhancing activities. Also, teachers need to ensure that the learning environment is distraction-free during DGBL activities. For game-designers or instructional designers it means that the game dynamics must cause players or learners to concentrate on the game or activity for it to be effective. There should be minimal information unconnected to the main mission or goal of the game. Because of the many benefits to learners when they are experiencing flow, the instructor should facilitate classroom activities that encourage flow to develop. If administered correctly, DGBL activities would facilitate developing a flow experience.

The fourth insight is that the questionnaire results showed that the student-players (i.e., EG participants) demonstrated that they most likely were experiencing flow since they satisfied all the dimensions required for a flow experience to develop. *SpaceteamESL* (1) adapts to the learners' skills so there is a balance of skill and challenge, (2) provides immediate (peer) feedback, (3) encourages constant concentration (as the game's time limits requires the players' full attention), (4) states the games' goals clearly at the start, (5) the players' have a sense of control over the game's progress (without any elements of luck or external influences), and (6) is quite enjoyable and pleasurable because of the constant meaningful learner interaction. The implication is that the instructor needs to be careful to ensure that all these dimensions are present as much as possible in his classroom or learning experiences. While students cannot be expected to experience flow throughout an entire lesson, they may enter and leave flow experiences (Pearce & Howard, 2004). Telltale signs for this are the three highest contributors to flow from this research: clear goals, concentration, and sense of control.

The fifth insight is at the lesson design level. There is a lot of literature in DGBL and Educational Technology about developing instructional models or strategies (e.g., Arifudin, Sulistyaningsih, & Kautsar, 2020). These models often deal with designing the skill and challenge of learning activities. They prioritize balancing skill and challenge when designing DGBL and other forms of learning. This common thought means developing instructional strategy and model of the activity should be prioritized. However, this research shows that what is more important in designing activities is the individual affective needs of the students (i.e., need to concentrate, see clear goals, and have a sense of control). The present research showed that these three affective needs of the students are more important than balancing student skill and the activity challenge. That is, the emphasis when developing or deploying DGBL activities is how the DGBL-activities meet these affective student needs. The way that the game manages challenge and skill level is clearly less important for the student. When designing DGBL activities or choosing digital games, instructors need to prioritize on how the game meets these three needs of the students (i.e., need for concentration, sense of control and clear goals). Furthermore, this should be communicated to students. Students should know they are valued. Their individual and personal affective state is most important. These affective needs play a central role in instructional design. They need to know that these individual needs are the most important.

The final insight came from the interviews. In the interviews the dominant themes were being positive, helpful, curious, mutually helpful, nervous, and intuitive. Most interviewees found the game positive and helpful in learning English and to be fun. Thus, instructors could use this game to reward students or motivate them to do something challenging. In addition to this, the fact that interviewees said that the game made them curious to understand English more shows that the game could be integrated into many lessons when the instructor wants to generate curiosity among students. Being mutually helpful or showing togetherness and teamwork was also an important theme. This is especially true during the time of the COVID-19 pandemic. The game can be used to build class community at the start of class or when the teacher thinks community building is needed. Lastly, according to some interviewees, successfully playing *SpaceteamESL* meant using intuition to guide their decision-making about how to listen and when to speak. What they meant by intuition knows how to listen for possible commands from many other game-players (i.e., scanning many sources). In other words, they are using peripheral listening (i.e., not listening intently to any one source but many). These are valuable skills when listening in certain situations. Intuition and peripheral listening means listening on the periphery. This intuitive listening means *SpaceteamESL* is a valuable tool to practice this kind of intuitive or peripheral listening.

It is hoped that this research sheds light on the role of DGBL in the language-learning classroom. Future research could look at different ways that videogames can be integrated into the classroom or the classroom curriculum. For example, future research could look at the impact on oral skill development or reading fluency in DGBL learning environments. The gameplay of *SpaceteamESL* practice both these kinds of language skills

There are several limitations to this study. First, one limitation is the duration of the gameplay. Throughout the 15-week semester participants played the game for 20 minutes for each of eight sessions. The total of their playing time was 160 minutes or just 2 hours and forty minutes over the span of the 15-week semester. In contrast to this, it has been recommended that one to two hours per gaming session is a more suitable time frame for serious game research (Loh & Sheng, 2014). Second, the make-up of the students may limit the generalizability of this study. The students were exclusively young Korean students at a vocational university. When generalizing this study beyond that demographic group, many other issues may need to be considered.

Conclusion

In summary, this paper's goal was to identify the impact of playing *SpaceteamESL* on student-players in an EFL class. This study considered how it impacted the players in two ways. First, it looked at how the game impacted the student-players' listening comprehension skills. Second, it looked at how the game impacted the student-players' flow experiences. This study showed that playing this video game contributed to student-players' listening comprehension skills. The implications of this result were discussed. Secondly, this paper showed that the computer game contributed to student-players developing a flow experience while they were playing the game. This paper has led to a better understanding of how computer games can be used and incorporated into a course. Nevertheless, computer games are not perfect. Computer games used for the purposes of language instruction have advantages and disadvantages. Educators and practitioners need to leverage all the advantages that computer games afford while minimizing the disadvantages of the computer game. Future research could look at using the same video game but in different contexts.

Third, the size of the sample limited the power of the data analysis and thereby the depth of the results. Because of sample size limitations, correlation coefficients, linear regression, and factor analysis could not be employed. Other studies could apply this research methodology to a larger sample size and develop results with greater breadth and depth. Fourth, part of this research study was based on a self-report questionnaire administered to students. Self-reporting is a valid way to access student learning experiences and views. But over-reliance on this form of research can limit valid findings. Future study could consider gathering further data than only relying on self-report data. Examples of other data forms are making observations of gameplay by either asking students to make screen-videos, which the teacher later collects, and analyses or physically monitoring learners' gameplay.

About the Author

David Berry is a graduate student in the PhD program at Kyunghee University, a professor at a vocational college in South Korea, and a homeschool dad. He has published widely and presented at numerous conferences about distance learning, digital game-based learning, and instructional design. He loves teaching and researching about new ways to integrate technology into learning.

To cite this article:

Berry, D. (2021). Level-up Learning: Video Games in an Online Class. *Teaching English as a Second Language Electronic Journal (TESL-EJ), 25*(1). https://tesl-ej.org/pdf/ej97/a22.pdf

References

Arifudin, D., Sulistiyaningsih, E., & Kautsar, I. A. (2020). Optimization of the Digital Game Based Learning Instructional Design (DGBL-ID) Method as Learning Support Media. *Jurnal Mantik*, *4*(3), 2147-2154.

Armstrong, J. S., & Overton, T. S. (1977). Estimating nonresponse bias in mail surveys. *Journal of Marketing Research*, 14(3), 396–402.

Bakker, M., & Wicherts, J. M. (2014). Outlier removal, sum scores, and the inflation of the type I error rate in independent samples t tests: The power of alternatives and recommendations. *Psychological Methods*, 19, 409. doi:10.1037/met0000014

Barta, E. (2010). Test takers' listening comprehension sub-skills and strategies. *WoPaLP*, *4*, 59-85.

Beck, J. C., & Wade, M. (2004). *Got game. How the gamer generation is reshaping business forever.* Harvard Business School Press.

Brown, H. D. & Lee, H. (2015). *Teaching by principles: An interactive approach to language pedagogy*. Pearson Education.

Buil, I., Catalán, S., & Martínez, E. (2019). The influence of flow on learning outcomes: An empirical study on the use of clickers. *British Journal of Educational Technology*, *50*(1), 428-439.

Casey, A., Goodyear, V. A., & Armour, K. M. (Eds.). (2016). *Digital technologies and learning in physical education: Pedagogical cases*. Taylor & Francis.

Chen, H., Wigand, R., & Nilan, M. (1999). Optimal experience of Web activities. *Computers in Human Behavior,* 15, 585–608.

Chen, J. (2007). Flow in games (and everything else). *Communications of the ACM*, 50(4), 31–34.

Choi, B., & Baek, Y. (2011). Exploring factors of media characteristic influencing flow in learning through virtual worlds. *Computers & Education*, 57(4), 2382-2394.

https://doi.org/10.1016/j.compedu.2011.06.019

Connolly, T. M., Boyle, E. A., MacArthur, E., Hainey, T., & Boyle, J. M. (2012). A systematic literature reviews of empirical evidence on computer games and serious games. *Computers & Education*, 59(2), 661–686. doi:10.1016/j.compedu.2012.03.004

Csikszentmihalyi, M. (1975). Purpose and Mind. Contemporary Psychology: *A Journal of Reviews*, 20(4). 352–353. doi:10.1037/0013305

Csikszentmihalyi, M., & Csikszentmihalyi, I. (1988). *Optimal experience: psychological studies of flow in consciousness*. Cambridge University Press.

Csikszentmihalyi, M. (1990). *Flow: The psychology of optimal experience*. Harper & Row.

Csikszentmihalyi, M., Rathunde, K., & Whalen, S. (1993). *Talented teenagers: The Roots of success and failure.* Cambridge University Press.

Csikszentmihalyi, M. (2000). *Beyond boredom and anxiety.* Jossey-Bass.

Csikszentmihalyi, M., Schneider, B., & Shernoff, E. S. (2014). Student engagement in high school classrooms from the perspective of flow theory. In *Applications of flow in human development and education* (pp. 475-494). Springer.

Davies, Mark. (2008) *The Corpus of Contemporary American English (COCA)*. Available online at *https://www.english-corpora.org/coca/*.

de Souza Silveira, M., & Cogo, A. L. P. (2017). The contributions of digital technologies in the teaching of nursing skills: an integrative review. *Revista gaucha de enfermagem*, *38*(2), e66204.

Din, F. S., & Calao, J. (2001). The effects of playing educational video games on kindergarten achievement. *Child Study Journal*, 31(2), 95–102.

Entertainment Software Association. (2019*). 2019 Essential Facts about the computer and video game industry* [Brochure]. ESA.

Erhel, S., & Jamet, E. (2013). Digital game-based learning: Impact of instructions and feedback on motivation and learning effectiveness. *Computers & Education*, *67*, 156-167.

Faul, F., Erdfelder, E., Lang, A. G., & Buchner, A. (2007). G*Power 3: A flexible statistical power analysis program for the social, behavioral, and biomedical sciences. *Behavior Research Methods*, 39, 175–191.

Garris, R., & Ahlers, R. (2001). A game-based training model: Development, application, and evaluation. Paper presented at the *2001 Interservice/Industry Training, Simulation, and Education Conference*.

Gee, J.P. (2007). *Good video games + good learning: Collected essays on video games, learning, and literacy*. Peter Lang.

George, D., & Mallery, M. (2010). *SPSS for Windows Step by Step: A Simple Guide and Reference*, 17.0 update (10a ed.). Pearson.

Goodwin-Jones, R. (2014). Games in language learning: Opportunities and challenges. *Language Learning & Technology* 18(2), 9–19. http://llt.msu.edu/issues/june2014/emerging.pdf

Gozcu, E., & Caganaga, C. K. (2016). The importance of using games in EFL classrooms. *Cypriot Journal of Educational Science*, 11(3), 126-135. https://doi.org/10.18844/cjes.v11i3.625

Greitemeyer, T., & Cox, C. (2013). There's no "I" in team: Effects of cooperative video games on cooperative behavior. *European Journal of Social Psychology*, 43(3), 224-228. *https://doi.org/10.1002/ejsp.1940*

Grimshaw, J., & Cardoso, W. (2018). Activate space rats! Fluency development in a mobile game-assisted environment. *Language Learning & Technology*, 22(3), 159–175. *https://doi.org/10125/44662*

Hamari, J., Shernoff, D., Rowe, E., Coller, B., Asbell-Clarke, J., & Edwards, T. (2016). Challenging games help students learn: an empirical study on engagement, flow, and immersion in game-based learning. *Computers in Human Behavior*, *54,* 170–179.

Harker-Schuch, I. E., Mills, F. P., Lade, S. J., & Colvin, R. M. (2020). CO2peration–Structuring a 3D interactive digital game to improve climate literacy in the 12-13-year-old age group. *Computers & Education*, *144*, 103705.

Holenko, M., & Hoić-Božić, N. (2008). Using Online Discussions in a Blended Learning Course. *International Journal of Emerging Technologies in Learning*, *3*.

Hulin, C., Netemeyer, R., & Cudeck, R. (2001). Can a reliability coefficient be too high? *Journal of Consumer* Psychology, 10(1), 55-58.

Johnson, L., Adams, S., Cummins, M., Estrada, V., Freeman, A., & Ludgate, H. (2013). *The NMC horizon report: 2013 higher education edition.*

Khan, A., & Pearce, G. (2015). A study into the effects of a board game on flow in undergraduate business students. *The International Journal of Management Education*, 13(3), 193–201. doi:10.1016/j.ijme.2015.05.002

Klit, K. J. M., Pedersen, K. S., & Stege, H. (2018). A prospective cohort study of game-based learning by digital simulation of a pig farm to train agriculture students to reduce piglet mortality. *Porcine health management*, *4*(1), 1-8.

Lantz, M. E., & Stawiski, A. (2014). Effectiveness of clickers: Effect of feedback and the timing of questions on learning. *Computers in Human Behavior, 31*, 280–286. doi:10.1016/j.chb.2013.10.009

Loh, C. S., & Sheng, Y. (2014). Maximum Similarity Index (MSI): A metric to differentiate the performance of novices vs. multiple experts in serious games. *Computer in Human Behavior, 39*, 322–330.

Lougheed, L. & Lougheed, L. (2007). *Longman preparation series for the new TOEIC test.* (4th ed.). Pearson Longman.

Mayer RE. 2016. What should be the role of computer games in education? *Policy Insights Behav. Brain Sci*.3(1):20–26.

McDonald, E. (2018). *South Korea Games Market 2018*. Retrieved December 1, 2018, from *https://newzoo.com/insights/infographics/south-korea-games-market-2018/*

McGonigal, J. (2011). *Reality is broken: Why games make us better and how they can change the world.* Penguin Books.

McQuillan, J., & Conde, G. (1996). The conditions of flow in reading: Two studies of optimal experience. *Reading Psychology, 17*(2), 109–135. doi:10.1080/0270271960170201

Montessori, M. (1967). *The discovery of the child*. Ballantine Books. Newmann.

Newcombe, J., & Brick, B. (2017). Blending video games into language learning. *International Journal of Computer-Assisted Language Learning and Teaching, 7*(4), 75–89. doi:10.4018/ijcallt.2017100106

Nussbaum, M., & de Sousa Beserra, V. (2014). Educational videogame design. In *2014 IEEE 14th International Conference on Advanced Learning Technologies*. IEEE.

Oblinger, D. G., & Oblinger, J. L. (2005). *Educating the net generation.* Online e-book: Educause.

Ogata, H., & Yano, Y. (2003). How ubiquitous computing can support language learning. In *Proceedings of Knowledge, Economy, and Development of Science and Technology* (pp. 1–6). Advanced Information Systems Engineering Laboratory. Papadima-Sophocleous.

Pearce, J. & Howard, S. (2004). *Designing for flow in a complex activity*. [Paper presentation]. 6th Asia-Pacific Conference on Computer–Human Interaction. ASCILITE.

Peterson, M. (2012). Learner interaction in a massively multiplayer online role-playing game (MMORPG): A sociocultural discourse analysis. *ReCALL*, 24(3), 361–380. doi:10.1017/s0958344012000195

Powers, D. E. and Schmidgall, J. E. (2018). *TOEIC Compendium of studies: Volume 3.* The Research Foundation for the TOEIC Tests. ETS. doi: *https://www.ets.org/s/toeic/pdf/research-compendium.pdf*

Prensky, M. (2001). *Digital game-based learning*. McGraw-Hill.

Procci, K., Singer, A., Levy, K., & Bowers, C. 2012. Measuring the flow experience of gamers: an evaluation of the DFS-2. *Computers in Human Behavior, 28*, 2306–2312.

Reinders, H., & White, C. (2010). The theory and practice of technology in materials development and task design. In N. Harwood (Ed.), *English Language Teaching Materials: Theory and Practice* (pp. 58–80). Cambridge University Press.

Sanchez, E., Young, S., & Jouneau-Sion, C. (2017). Classcraft: from gamification to ludicization of classroom management. *Education and Information Technologies*, *22*(2), 497-513.

Sanford, K. & Madill, L. (2007). Understanding the power of new literacies through video game play and design. *Canadian Journal of Education*, *30*(2), 432-455.

Schiefele, U., & Csikszentmihalyi, M. (1995). Motivation and Ability as Factors in Mathematics: Experience and Achievement. *Journal for Research in Mathematics Education*, *26*(2), 163. doi:10.2307/749208

Sewell, H. D. (2005). *The TOEIC: Reliability and Validity Within the Korean Context*. https://www.birmingham.ac.uk/documents/college-artslaw/cels/essays/testing/testing/sewelltesting.pdf

Shernoff, D. J. (2013). *Optimal learning environments to promote student engagement.* Springer.

Shernoff, D., & Csikszentmihalyi, M. (2009). Flow in schools. Cultivating engaged learners and optimal learning environments. In R. Gilman, E. S. Huebner, & M. J. Furlong (Eds.), *Handbook of positive psychology in schools* (pp. 131–145). Taylor & Francis Group.

Sheskin, D. (2011). *Handbook of parametric and nonparametric statistical procedures*. Chapman & Hall/CRC.

Shin, N. (2006). Online learner's flow experience: An empirical study. *British Journal of Educational Technology*, *37*(5), 705–720. doi:10.1111/j.1467-8535.2006.00641.x

Smith, H. (2012). *Spaceteam* [Mobile application software]. Retrieved from *http://spaceteam.ca*

Stockwell, G. (2010). Using mobile phones for vocabulary activities: Examining the effect of platform. *Language learning & technology*, *14*(2), 95-110.

Warschauer, M., & Healey, D. (1998). Computers and language learning: An overview. *Language Teaching*, *31*(2), 57–71.

Wang, C., & Hsu, M. (2014). An exploratory study using inexpensive electroencephalography (EEG) to understand flow experience in computer-based instruction. *Information & Management*, *51*, 912–923.

Webster, J., Trevino, L. K., & Ryan, L. (1993). The dimensionality and correlates of flow in human-computer interactions. *Computers in Human Behavior, 9*(4), 411–426. doi:10.1016/0747-5632(93)90032-n

White, B. Y. (1984). Designing computer games to help physics students understand Newton's laws of motion. *Cognition and Instruction,* 1(1), 69–108.

Zaiontz, C. (2020) Real Statistics Resource Pack software (Release 7.6) [Computer software]. https://www.real-statistics.com/

Appendix

Flow Questionnaire

	Item	Extremely disagree	Disagree	Don't agree or disagree	Agree	Extremely agree
1	I believed my computer skills would allow me to meet the challenge in playing Spaceteam ESL.					
2	I considered the challenge of the competition and my language skills to be at an equally high level.					
3	I have sufficient language skills needed to play Spaceteam ESL well.					
4	It is difficult for me to play Spaceteam ESL well.					
5	The goals were clearly defined.					
6	I knew what I had to do.					
7	I knew what I had to achieve.					
8	I know how well I am doing.					
9	I receive feedback on my progress in the game.					
10	I am completely focused on playing Spaceteam ESL.					
11	My attention was focused entirely on what I was doing.					
12	It required no effort to keep my mind on the game.					
13	I think about nothing else.					
14	The greater the effort, the better my performance.					
15	I consider myself responsible for the results of playing Spaceteam ESL.					
16	I have a high degree of control over my performance in playing Spaceteam ESL.					
17	I really enjoy playing Spaceteam ESL.					
18	I feel good while playing Spaceteam ESL.					
19	I found the experience playing Spaceteam ESL extremely rewarding.					
20	I want to play Spaceteam ESL again.					
21	Playing Spaceteam ESL was useful for my language learning.					
22	Playing Spaceteam ESL helped me improve my speaking skills.					
23	Playing Spaceteam ESL helped me improve my listening skills.					
24	I found playing Spaceteam ESL valuable.					
25	I am very satisfied with playing Spaceteam ESL.					
26	I had a very positive learning experience while playing Spaceteam ESL.					