

Collaborative Learning via Mobile Language Gaming
and Augmented Reality:
Affordances and limitations of technologies

by

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B.A., University of Victoria, 2012
M.A., University of Victoria, 2015

A Dissertation Submitted in Partial Fulfilment of the
Requirements for the Degree of

DOCTOR OF PHILOSOPHY

In Interdisciplinary Studies

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We acknowledge and respect the lək'wəŋən peoples on whose traditional territory the
university stands, and the Songhees, Esquimalt and WSÁNEĆ peoples whose historical
relationships with the land continue to this day.

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Abstract

This research explores collaborative second language (L2) learning in gamified environments, and specifically examines affordances and limitations of mobile gamified language systems and augmented reality (AR) in supporting collaborative L2 learning. Therefore, this design-based research entailed the development and evaluation of two L2 AR gamified collaborative learning tools, *Explorez* and *VdeUVic*. At different locations on campus, players interact with characters that give them quests including clues or options to further the storyline. The gameplay interactions were designed to take place either in the form of written text or audio and video recordings, encouraging students to practice both oral and written language competencies. Three cohorts of FL2 university students playtested both gamified systems, and 58 students chose to participate in the study. The evaluation of the AR language tools was implemented by means of mixed-method case studies, collecting data of both a qualitative and quantitative nature, through pre- and post-play questionnaires, interviews, and video recordings of student gameplay interactions for analysis. This research examined the learners' perceptions of their learning experience and in what ways students collaborated to complete the tasks. Additionally, the adaptation of Volet et al.'s (2009) collaborative learning framework permitted the examination of the learners content processing and social regulation during gameplay. The findings suggested the potential of AR gamified environments to facilitate high levels of interaction and collaboration. The analysis showed distinct patterns of collaborative learning across groups and sessions. Additionally, the findings identified patterns in the emergence of learners' high-level co-regulation, as well as factors that assisted students in sustaining engagement of high-level co-regulation during gameplay.

Table of Contents

Supervisor Committee	ii
Abstract	iii
Table of Contents	iv
List of Tables	viii
List of Figures	ix
Introduction.....	1
1.1 Context.....	1
1.2 Motivation.....	3
1.3 Research goal and questions	5
1.4 Methodology	6
1.5 Contributions	9
1.6 Organization of the dissertation	10
Chapter 2. Related Work.....	12
2.1 Augmented reality and mobile learning.....	12
2.3 Collaboration in digital games	16
2.4 Mobile gameful L2 collaborative learning	20
2.5 Mobile AR and collaborative language learning	22
2.6 A Framework for the analysis of collaborative learning	31
2.7 Theoretical framework.....	32
2.7.1 Self-determination theory	32
2.7.2 Situated learning theory	33
2.7.3 Sociocultural theory	35
2.7.4 Gaming research	36
Chapter 3. Methodology	39
3.1 Gamified learning systems.....	47
3.1.1 Explorez	47
3.1.1.1 YouTube: videos and movie trailers	49
3.1.1.2 FrancoToile	50
3.1.1.3 Voki.....	50
3.1.1.4 Twitter.....	51

3.1.2 Explorez 2.0 quests and game elements	51
3.1.3 Description of the tool VdeUVic	55
3.1.4 Development additions, modifications, and challenges.....	57
3.1.4.1 ARIS 2.0 scenes	59
3.1.4.2 Challenges with Twitter	60
3.1.4.3 ARIS AR camera overlay feature	62
3.1.4.4 Voki.....	63
3.1.4.5 Additional gaming elements	63
3.2 User study/Participants	66
3.2.1 Participant profiles	69
3.2.1.1 Experience with digital media	71
3.2.1.2 Gaming experience, motivation, and use	73
3.2.1.3 Mobile gameplay	74
3.3 Data collection	75
3.4 Procedure	77
3.4.1 Data set 1 - Fran160 Fall 2018.....	78
3.4.1.1 Fran 160 Session 1	78
3.4.1.2 Fran 160 Session 2	79
3.4.1.3 Fran 160 Session 3	80
3.4.2 Data set 2 – Fran 120 Spring 2019.....	81
3.4.2.1 Fran 120 Session 1	81
3.4.2.2 Fran 120 Session 2	82
3.4.2.3 Fran 120 Session 3	83
3.5 Data analysis	83
3.5.1 Analysis of student interview data and questionnaire responses	83
3.5.2 Analysis of student gameplay video data for collaborative episodes	83
3.5.3 Analysis of student gameplay video data for collaborative learning.....	85
3.5.4 Analysis of student gameplay video data for learning context	93
3.6 Data illustrations	94
Chapter 4. Findings.....	101
4.1 Player experience details.....	101
4.1.1 Participants identified strengths and limitations of the tools.....	103

4.1.2	Participants rating of gamified tools usefulness as a FL2 learning activity	106
4.1.3	Issues during gameplay.....	107
4.1.4	Participants rating of gaming elements as learning motivators	110
4.1.5	Gaming elements identified as useful for L2 learning.....	112
4.1.6	The relevance of ‘place’ as identified by the participants	114
4.2	Participants collaborative interactions: L2, technology and gameplay	115
4.2.1	Fran 160 participants collaboration	116
4.2.2	Fran 120 participants collaboration	122
4.2.3	Fran 100 participants collaboration	126
4.3	Participants collaborative learning.....	129
4.3.1	Students focus of interactions during gameplay	131
4.3.2	Emergence of high-level co-regulation.....	139
4.3.3	Contributing factors to sustained high-level co-regulation.....	139
4.4	L2 learners group interactions in the AR gaming environment.....	144
4.4.1	Duration on gameplay.....	145
4.4.2	Time on and off task	148
4.4.3	Lapses in silence	150
4.4.4	Participants use of an online dictionary	151
4.4.5	Percentage of French versus English spoken during the task	153
4.4.6	Group cohesion and laughter during gameplay	154
4.4.7	Tweets	160
Chapter 5.	Discussion of Findings and Conclusions	162
5.1	Implications for gamified learning design and development.....	162
5.1.1	Participants’ perception of the learning experience.....	163
5.1.2	Game design, development lessons and insights	170
5.1.2.1	Hacks.....	171
5.1.2.2	Avatars	172
5.1.2.3	Feedback and scaffolding	173
5.1.2.4	Technical issues	176
5.2	Collaborative learning in gamified AR environments	179
5.2.1	Patterns of collaborative learning	186
5.2.2	Factors contributing to the emergence of high-level co-regulation.....	189

5.2.3 Factors contributing to sustaining high-level co-regulation	190
5.3 Language learners group interactions in a gamified AR environment	192
5.3.1 Interactions through Gameplay	192
5.3.2 Interactions during time off task	194
5.3.3 Lapses, language use and online dictionaries	196
5.3.4 Twitter	199
5.4 Implications of AR in language learning and teaching contexts	201
5.4.1 Developing AR learning environments and experiences	202
5.4.2 Implementing AR learning environments and experiences	203
5.5 Theoretical and methodological contributions.....	205
5.6 Limitations and conclusions	207
References.....	213
Appendices.....	226
Appendix A Pre-questionnaire.....	226
Appendix B Post-questionnaire	233
Appendix C Interview questions.....	240
Appendix D Explorez 2.0 Quest details.....	241
Appendix E Excerpt 5	253

List of Tables

Table 1. A Summary of the method in the present study.....	46
Table 2. Participants per course level.....	67
Table 3. Fran 160 testing groups.....	68
Table 4. Fran 120 testing groups.....	69
Table 5. Fran 100 testing groups.....	69
Table 6. Experience with digital media.....	71
Table 7. Frequency of social media use.....	72
Table 8. Participants attitude towards using technology for learning.....	72
Table 9. Participant gaming experience.....	73
Table 10. Motivation when playing a video game.....	74
Table 11. Detailed summary of data set information.....	77
Table 12. Spreadsheet coding example Fran 160.....	91
Table 13. Example of percentage of time spent per category.....	92
Table 14. Participants responses describing their experience with the tools.....	101
Table 15. Overall player experience rating per session of gameplay.....	102
Table 16. Participant rating of tools as useful as a French language activity.....	106
Table 17. Participants rating of gaming elements as learning motivators.....	111
Table 18. Gaming elements identified as useful for L2 learning.....	112
Table 19. Effectiveness of Twitter.....	113
Table 20. Satisfaction using Twitter to make video or audio recordings.....	114
Table 21. Collaboration type Fran 160.....	117
Table 22. Collaboration type Fran 120.....	123
Table 23. Collaboration type Fran 100.....	127
Table 24. Fran 160 interactions.....	133
Table 25. Fran 120 interactions.....	137
Table 26. Fran 160 L2 learners group interactions.....	149
Table 27. Fran 120 L2 learners group interactions.....	149
Table 28. Participants experience playing in a group.....	156
Table 29. Participants opinion of teamwork during gameplay.....	156
Table 30. CL tasks (1-6).....	158
Table 31. CL tasks (7-12).....	159

List of Figures

Figure 1. Design Science Research Methodology Process	41
Figure 2. Examples of NPCs and map in Explorez 2.0.....	48
Figure 3. Conversations tab	52
Figure 4. Possible player quest progression.....	54
Figure 5. Screenshot of Explorez 2.0 UI map view.	58
Figure 6. Scenes UI of Explorez imported into ARIS 2.0	59
Figure 7. Nine of Explorez 2.0's 12 scenes visible in the UI of ARIS	61
Figure 8. Collaborative learning framework.....	86
Figure 9. Fran 160 teams' collaborative episodes (type and frequency)	119
Figure 10. Fran 120 teams' collaborative episodes (type and frequency)	125
Figure 11. Fran 100 teams' collaborative episodes (type and frequency)	128
Figure 12. The main UI of ARIS editor	252

Introduction

According to the ESAC (Entertainment Software Association of Canada, 2020), there are currently 23 million Canadian gamers, representing 61% of the population. Contrary to the dated stereotype of players consisting primarily of male adolescents, 50% of gamers in Canada are women and the average age is 34 years. Additionally, 89% of Canadian youth, aged 12-17, play games on a regular basis (ESAC, 2020). On a global scale, in 2017 mobile game revenues rose substantially surpassing the combined sales for all other gaming platforms combined by more than 33% (Dealessandri, 2018). Gaming is a ubiquitous form of entertainment and can now be enjoyed anytime, anywhere. Yet, these games also go beyond mere entertainment. Research supports that video and computer games can improve hand-eye coordination, enhance creativity, and develop decision-making and problem-solving skills (Adachi & Willoughby, 2013; Bavelier et al., 2012; Jackson et al., 2012; McGonigal, 2011; Uttal et al., 2013). Many of these games require perseverance to advance and obtain a 'win' state, and some require collaboration to succeed, thereby encouraging team play and building collaborative skills (Gee, 2003; McGonigal, 2011). Furthermore, a well-developed video game can keep a player enthralled for hours (Gee, 2003). Given the popularity of games, as well as their potential to facilitate learning, many researchers and educators are seeking to incorporate game-based mechanics and gameplay into educational contexts; otherwise known as gamifying learning.

1.1 Context

Employing games in education is by no means a new idea, and a substantial amount of research has examined incorporating digital learning games into the classroom (Egenfeldt-Nielsen, 2006).

Research findings have indicated positive results concerning engagement and learning outcomes (Becker, 2001; Betz, 1995; Levin, 1981; Rosas, et al., 2003; White, 1984). However, this area of research entails employing already made commercial video games. The gamification of learning can be considered another branch of research within the broader context of gaming in education (Kapp, 2012).

Kapp (2012) defines gamification as “using game-based mechanics, aesthetics and game thinking to engage people, motivate action, and promote learning” (10). Gamification employs game design principles to convert non-game like learning content into an engaging game-like environment. This entails using game mechanics, such as points, levels, and badges, as well as considering the learner/player experience, in order to develop an engaging learning environment (Kapp, 2012). Well-developed gamified systems do not simply give out rewards for mundane tasks (Werbach & Hunter, 2012). According to game design expert Jane McGonigal, gamified systems fall short if they do not also adopt “the spirit of a game” and “gamefulness” (Takahashi, 2011).

In an educational context, researchers have examined gamification as a pedagogical method (Endarto, 2018; Flores 2015; Natkin, 2009; Marne et al., 2011; O’Donovan, 2012; Sanchez et al., 2011). Other studies explore means to effectively integrate this type of learning environment into specific learning contexts (Charles et al., 2011; Cruaud, 2016; Kumar, 2012; Simões et al., 2013). Moreover, studies continue to emerge with focus on the effects of gamified learning (Garzón et al., 2019; Haskell, 2013; Hwang et al., 2016; Parmaxi & Demetriou, 2020). For example, Haskell’s (2013) study examined integrating quest-based learning and game mechanics into a university level educational technology course. Findings indicated students found game-

based feedback motivating and meaningful, and the participants in the quest-based course received higher grades overall than those in the equivalent traditional course. Additionally, even after having met the requirements to obtain an “A” in the course, 55% of the students continued to quest, thereby continuing their autonomous learning. Gamifying learning has been implemented with positive outcomes in a wide range of learning contexts, as well as age groups, from primary school to university-level students (Kapp, 2012). However, studies specifically examining gamification, and second language (L2) acquisition remain sparse (Reinhardt, 2019). Furthermore, although there are a growing number of studies examining gamifying learning, according to Dichev and Dicheva (2017) many reported results lack sufficient evidence for valid claims in regards to its effectiveness.

1.2 Motivation

The present research builds on Perry’s (2015) MA thesis, which focused on the motivation and engagement potential of gamifying second language learning. Perry’s (2015) study entailed the development and implementation of the gamified prototype learning-tool *Explorez* for first-year university-level French students. The original design of *Explorez* centered around collaboration, but its effect on collaboration was not tested in the study. The researcher did, however, note examples of a sociocultural learning effect during gameplay. Sociocultural research focuses on the social nature of L2 learning, and this perspective draws on Vygotsky’s (1986) concept of zone of proximal development (ZDP). The ZDP is considered the difference between what a learner can accomplish individually, and what they can achieve collaboratively with the mediation of a peer, instructor and/or learning tool (Lantolf & Thorne, 2006). During playtesting of *Explorez*, Perry

observed participants collaborating to decide next steps in the game, as well as many examples of more advanced students helping the lesser-advanced ones navigate the system or quest and supplying the necessary vocabulary word or information. Given the value of collaborative learning (CL), this merits further study to examine in what ways gamified learning tools impact CL.

In regards to collaborative learning (CL), research supports numerous benefits (see Johnsons, 1989 and Panitz 1999 for a list of over 50 CL benefits). These learning benefits are social (i.e., the development of learning communities and social support for learners), psychological (i.e., student-centered learning increases self-esteem, and cooperation can reduce anxiety), and academic (i.e., students are actively involved in the learning process, and CL encourages critical thinking skills) (Laal, & Ghodsi, 2012). Additionally, research supports the potential of CL in gamified learning systems (Bacca et al., 2014; Garzón et al., 2019; Godwin-Jones, 2016). However, most of this research only acknowledges collaboration as an affordance in gamified learning environments, and/or recommends developing the tools to include collaborative gaming (Dunleavy, Dede, & Mitchell, 2009; Laine, 2018; Wu et al., 2013). Research specifically analysing CL in gamified learning environments remains limited. Therefore, this research aims to partially fill the present gap regarding gamifying language learning by means of focusing on collaboration and augmented realities (AR).

When this research began, there were no known studies exploring collaborative learning in AR L2 gamified environments. Therefore, a substantial amount of research also pertained to exploring frameworks for the analysis of CL that would best suit not only the gamified learning context, but also the analysis of video data. Ultimately, Volet et al.'s (2009) CL framework was adapted for the present research. Volet et al.'s study examined high-level co-regulation during

collaborative learning by combining the concepts of social regulation and content processing. Social regulation within a group of learners varied between individual regulation within a group of learners to co-regulation as a group. The learner's content processing ranged from low level content processing on one end (such as acquiring knowledge), to high level content processing (constructing meaning) on the other. This framework therefore created four categories for coding the video data (low-level individual regulation, low-level co-regulation, high-level individual regulation, and high-level co-regulation). The coding subsequently allowed the data to be examined in three ways: the focus of interactions, patterns regarding the emergence of high-level co-regulation, and contributing factors to sustained high-level co-regulation.

1.3 Research goal and questions

The goal of this research is to study collaborative L2 in gamified environments, and specifically to examine affordances and limitations of mobile gamified language systems and augmented reality in supporting collaborative second language learning. Thus, this research will address the following research questions:

RQ1 What are the participants' perceptions of their learning experience?

RQ2 Which elements do they identify as useful or not for language acquisition?

RQ3 How do they collaborate in order to complete the tasks?

RQ4 In what ways do L2 learners socially regulate and process content during gameplay?

RQ5 What are the characteristics of language learners' group interactions in a gamified augmented reality environment?

1.4 Methodology

In order to address the research questions, Peffers et al.'s (2007) design science framework, a form of design-based research (DBR), was employed. This framework consists of six activities to progress through the research process.

- 1. Problem identification and motivation:** The problem this research addressed was a gap in the research on gamified systems supporting L2 collaborative learning. Although current research acknowledges the CL potential of gamified systems, and/or recommends collaborative gaming concepts for design, the vast majority of studies examining gamified learning do not focus on CL.
- 2. Definition of solution objectives:** In order to study the limits and affordances of these technologies, an operational gamified system(s) was required. Participants could then playtest the systems in order for the researcher to ascertain what worked and what did not work to make improvements to the artifacts. This process was completed three times, with a different iteration of the tools for each cohort of students. Thus, DBR allowed for the design and iterative development of the gamified systems, as well as the opportunity to return to prior stages (such as design and development) during and after evaluating the artifacts.
- 3. Design and development:** A first step to the present research was therefore the re-design and development of the next iterations of both AR gamified environments, *Explorez 2.0* and *VdeUVic* incorporating student feedback and observational data from previous testing. The theoretical framework for this DBR draws on several learning theories, as well as gaming research for the design and development stages. A main goal in gamification is to unite extrinsic and intrinsic learning motivators (Werbach & Hunter, 2012). Thus, the next iterations of the tools included a diverse range of elements in order to appeal to the largest demographic possible. Extrinsic motivators, such as points and badges of accomplishment appeal to some players, while others are drawn to intrinsic learning motivators. This

research is also informed by situated learning theory with the goal of providing a contextual and immersive learning experience for the students. Therefore, both gamified systems were designed to include gaming tasks that incorporated real-world locations with contextual relevant content that also reflected the course learning content.

The design of the tools affects CL potential, hence the justification for the first two RQs concerning player/learner experience, and identifying the specific gaming elements that are motivating and useful for L2 learning. The instruments for RQ1 and RQ2 were a post-play questionnaire and semi-directive interviews, and the data analysis procedure entailed descriptive statistics.

4. **Demonstration of artifact usage:** Three cohorts of different level FL2 university students playtested both gamified systems. Ninety-seven students played *VdeUVic*, 78 of the 97 students also played *Explorez*, and 58 students chose to participate in the study. The evaluation of the AR language tools was implemented by means of mixed-method case studies, collecting data of both a qualitative and quantitative nature, through pre- and post-play questionnaires, interviews, and video recordings of student gameplay interactions for analysis. Additionally, this study draws on sociocultural theory and the social nature of language learning, emphasizing learner interactions as a principal learning force. As mentioned above, this research is also informed by other theoretical contexts (self-determination theory, situated cognition, and gaming research). This combined theoretical framework guided not only the design and development of the gamified learning tools, and the design of the research, but also helped frame the research questions and interpret the data.
5. **Observation and measurement:** Data from testing cohort 1 (video data, questionnaires, interviews) was compiled and analyzed to then return to the design and development stage and incorporate the findings. Some data from cohort 2 testing (video data, questionnaires, interviews) was also compiled and analyzed to again reiterate back and incorporate the findings (overlapping testing sessions of cohort 2 and 3 resulted in time constraints that impeded the extent of data analysis; therefore, it was not as comprehensive as the previous

analysis after cohort 1 testing). Data from cohort 3 testing was compiled and analyzed for the following dissertation. The instruments for RQ3, RQ4, and RQ5 were video recordings of student gameplay, and the data analysis procedure used descriptive statistics.

RQ3 examined how students collaborated to complete the tasks. The transcribed video recordings were coded for language collaboration, technical collaboration, and gameplay collaboration. The findings for this analysis suggested the potential of the AR gamified environments to facilitate high levels of interaction and collaboration. The findings also illustrated distinct types of learner interactions amongst teams during gameplay.

Cohort 3 was excluded from RQ4 and RQ5 because a preliminary analysis showed that this cohort relied more so on the accompanying language expert (researcher/TA) for game comprehension than the other students. Since the present research sought a close analysis of L2 students' collaborative learning, the data coding and analysis employing Volet et al.'s framework was restricted to data sets 1 and 2. These two cohorts had either no accompanying language expert or limited interference from the accompanying researcher/TA. The transcribed video recordings were coded for high-level content-processing episodes (individual or co-regulation) and low-level content-processing episodes (individual or co-regulation) to address RQ4 regarding how L2 learners socially regulate and process content during gameplay. The analysis showed distinct patterns of collaborative learning across groups and sessions. Additionally, the findings identified patterns in the emergence of learners' high-level co-regulation, as well as factors that assisted students in sustaining engagement of high-level co-regulation during gameplay. The adapted framework, which examined how students socially regulate and process content, was found to be useful in identifying patterns of interaction during gameplay of the AR L2 gamified systems.

The transcribed video recordings were also coded for duration of gameplay, percentage of time on and off task, lapses of silence, use of an online dictionary, percentage of French vs English spoken during the task, and the number of times two or more group members laughed during gameplay. This data analysis addressed RQ5 concerning the

characteristics of language learners' interactions as a group in the AR environment. Findings showed that overall, the participants spent the vast majority of time on task, and most of the time processing content. The results of this analysis also highlighted that it is not only students' language abilities that impact their learning experience in these gamified environments, but that other competencies pertaining to technology and gaming play a role. Additionally, factors such as group cohesion and positive emotions also affect CL. Finally, implications for developing, and implementing AR learning environments in language learning and teaching courses/contexts were considered.

6. **Diffusion:** The resulting knowledge from this research is shared in the following dissertation.

1.5 Contributions

This research adds to the emerging body of research on gamifying learning with the following four contributions:

1. Collaboration patterns in gamified learning environments and more generally in language learning.
2. Adaptation of Volet et al.'s (2009) collaborative learning framework for a gaming AR learning context. The detailed coding and analysis employing spreadsheets was also an iterative process and may be of interest for future research on collaborative learning. The addition of the present research employing the framework to also code non-verbal instances of low and high, individual and co-regulation may also be of interest to future research, and merit further investigation.
3. Specific instruments to analyze the learners' experiences during gameplay (methodological contribution).
4. This dissertation not only presents examples of gamified learning-tools in practice, it also offers the detailed development of the gamified systems that may help guide others (developers, researchers and/or instructors) in the design process of future gamified learning environments or games. This research also provides an example of how to

implement an AR gamified environment in a course setting. The detailed logistics and the lessons learned presented in this dissertation may assist other instructors/researchers with the implementation of learning games or gamified systems.

1.6 Organization of the dissertation

This dissertation is presented in five chapters. *Chapter 2* provides the context of the study with an overview of the current state of research pertaining to gamifying FL2 learning. First, focus is placed on empirical studies in the domain of AR and mobile learning, as well as collaboration in digital games. Next, narrowing the focus, research on mobile gameful L2 collaborative learning, and more precisely mobile AR and collaborative language learning are examined. Finally, the theoretical contexts on which this design-based research draws are detailed; self-determination theory, situated cognition, as well as sociocultural and gaming research.

In *Chapter 3* the methodology of the research is detailed including the participant profiles, data collection methods, and procedure. This chapter also details the design and iterative development of the two AR gamified L2 learning environments. Several challenges are examined, and the steps employed to overcome them. Next, the analysis of the data is described. The framework for the analysis of collaborative learning (CL) during gameplay is also developed, and details regarding the adaptation of Volet et al.'s (2009) framework are provided.

Chapter 4 presents the findings in the context of the research questions. *Chapter 5* summarizes the research and discusses the findings in terms of the research questions. Implications for gamified learning design are detailed, and CL in gamified AR environments is examined. Next, benefits and limitations of the AR tools for language learning are discussed, as well as implications

for the implementation of AR in language learning and teaching contexts. Finally, limitations to this research and potential future research are addressed, as well as conclusions.

Chapter 2. Related Work

This chapter provides related works and rationale for my proposed research. Given that research pertaining specifically to gamifying collaborative language learning is limited, the following literature review draws on relevant studies from other domains pertaining to gamified learning, AR and collaborative gaming. First, this chapter examines the current state of research on the broader topics of AR and mobile learning, and collaboration in digital games. Next, the examination narrows and focuses on research regarding mobile gameful L2 collaborative learning and more precisely mobile AR and collaborative language learning. Finally, the theoretical framework entailing several different learning theories for the present design-based research is detailed, specifically, self-determination theory, situated learning theory, sociocultural theory, and gaming research.

2.1 Augmented reality and mobile learning

Augmented reality combines the real world and virtual elements with the goal of creating an immersive and enhanced experience (Bronack, 2011; Klopfer & Squire 2008). More precisely, AR can be defined as “experiences that overlay graphics, video streams, or holograms in the physical world” (Microsoft Docs, 2021). Users view this digital layering on the interface of their mobile

device. This is not to be confused with virtual reality, which is complete immersion in a virtual environment by means of a headset. However, for some researchers the definition of AR is restricted to 3D digital elements. For example, according to Azuma (1997) and Chen et al. (2019), AR superimposes the real-world with 3D virtual objects, and allows for real-time interaction. However, Klopfer and Squire (2008) provide a broader definition indicating AR is “a situation in which a real-world context is dynamically overlaid with coherent location or context sensitive virtual information” (205). Nunes et al. (2021) define AR as the simultaneous combination of virtual objects via the screen of a user’s technical device, with elements in the user’s real-world environment. These broader definitions allow for the inclusion of 2D virtual overlays superimposed with the real world viewed on a user’s device and can employ different technologies such as GPS or an AR camera overlay feature.

Given the ubiquitous presence of mobile technologies, in educational contexts AR has acquired substantial attention in the past decade. Mobile devices (such as smartphones or tablets) can trigger digital information and/or game elements by means of the device’s GPS or by utilizing camera recognition software. This provides students with technology-mediated immersive experiences, blending the real world with virtual elements (Klopfer & Sheldon, 2010). One of the main affordances of these immersive environments is their potential to increase learner interaction and engagement (Dunleavy, Dede, & Mitchell, 2009). However, similar to other technologies, the educational benefits of AR are not uniquely based on the capabilities of the technology, but also on the ways in which educators design the systems that employ AR and integrate these into the learning environment.

A significant amount of research continues to emerge on AR within a wide range of learning domains (Bacca et al., 2014; Garzón et al., 2019). A large portion of this work remains exploratory in nature; however, studies pertaining to the effects of AR regarding teaching and learning are promising (Garzón et al., 2019). Currently, the majority of AR systems for learning are developed for subjects in sciences, and mathematics (Laine, 2018; Garzón et al., 2019). Many of the studies consist of design-based research, entailing the development and implementation of an AR game with the aim of creating an immersive participatory learning environment (Dunleavy, Dede, & Mitchell, 2009; Gagnon, 2010; Holden & Sykes, 2011; Roy & Frandy, 2013; Tobar-Muñoz et al., 2017). For example, Dunleavy, Dede, and Mitchell's (2009) cross-case study explored the educational benefits and limits of AR technologies from the perspective of both students and teachers. Their game, *Alien Contact!*, incorporated elements present in well-developed video games, such as narrative, different roles, and collaboration, with the game being designed to foster literacy skills in science, math, and language arts. As the research advanced, a theoretical framework for effective AR learning environments was developed, and subsequently employed for each stage of research, as well as the analysis of data. Findings indicated a high level of student engagement due to the unique affordances of the hybrid immersive environment, as well as the collaborative work necessary to solve problems and advance in the game. Furthermore, teachers' responses highlighted that engagement and motivation were particularly evident on the part of students who had previously shown academic and behavioural difficulties in conventional classroom environments.

In recent years, there have been several reviews on educational mobile AR (Bacca et al., 2014; Garzón et al., 2019; Godwin-Jones 2016; Laine 2018; Tovar, Jonker & Hurst, 2020). Bacca

et al.'s (2014) review focuses on subject matter, advantages, limitations, and efficacy. Godwin-Jones' (2016) review focuses on AR platforms and games specifically for L2 learning. Tovar, Jonker and Hurst's (2020) AR review centres on pedagogical methods, learning outcomes, and challenges. Despite varying foci, all these reviews discuss collaboration. In regards to AR use in an educational context. Collaboration is reported as an advantage (Bacca et al., 2014; Garzón et al., 2019), a pedagogical method (Tovar et al., 2020), and a theoretical context for development (Laine, 2018). In regards to AR game design specifically for L2 learning, Godwin-Jones (2016) states that gameplay requiring collaboration and communication is a "no brainer".

Research therefore supports the potential of gamified systems to facilitate collaborative learning environments. Yet, this body of work mainly addresses collaboration as an affordance of AR learning environments and suggests including collaborative gaming in the development of an AR system (Dunleavy, Dede, & Mitchell, 2009; Kaufmann, 2003; Laine, 2018; Specht, Ternier, & Greller, 2011; Wu et al., 2013). For example, Dunleavy, Dede, and Mitchell's (2009) AR game employed a 'puzzle' method, which entailed different player roles having access to different pieces of information, with players therefore being required to work together to progress in the game. However, future research needs to delve deeper, in order to examine the effects of collaboration in AR environments, as well as to ascertain which collaborative gaming elements transfer well to specific learning contexts. Furthermore, appropriate data collection methods for examining collaboration and interaction are also necessary in future studies. Bacca et al. (2014) note a lack of data collection methods such as focus groups and conversational analysis, despite interaction and collaboration emerging as main affordances of AR in an educational context.

Augmented reality mobile learning remains an emerging domain with many areas yet to be explored. The potential however is acknowledged, and educational researchers are increasingly recognizing the possibilities and effectiveness AR holds for teaching and learning (Garzón et al., 2019). However, there remains a need for rigorous empirical studies to better understand the effects of AR on learning (Laine, 2018), and more specifically the effects of collaboration in these gamified systems.

2.3 Collaboration in digital games

Reinhardt (2019) highlights that the development of an educational game is an interdisciplinary process. Additionally, Crookall (2010) details that simulation/gaming for a learning context entails:

an array of methods, knowledge, practices, and theories, such as simulation, gaming, serious game, computer simulation, computerized simulation, modeling, agent-based modeling virtual reality, virtual world, experiential learning, game theory, role-play, case study, and debriefing” (899).

Although the present research encompasses gamified language tools and does not fall within the definition of an educational game, this highly interdisciplinary process holds true for those who are developing a gamified learning environment which focuses on the learner experience and seeks to adopt “the spirit of a game” and “gamefulness” as defined by Takahashi (2011). Consequently, the present study also draws on video game research.

Researchers have analyzed collaboration in video games, such as player behaviour, to design better collaborative games (Rocha, Mascarenhas, & Prada, 2008; Seif El-Nasr et al., 2010). For example, Seif El-Nasr et al.’s (2010) study examined a range of commercial multiplayer games

to develop a comprehensive list of collaborative patterns, as well as Cooperative Performance Metrics (CMPs) to analyze these patterns. Understandably, not all of these patterns or CMPs will necessarily transfer to a gamified learning environment; developers and educators must employ those that will suit their game design and learning goals. However, these patterns are a useful starting point when designing a collaborative gaming environment. For example, the present research incorporated three of these collaborative patterns in the next iteration of the gamified learning tools: *complementary roles*, *shared goals*, and *limited group resources*. Additionally, three of the metrics are also relevant for inclusion: *laughter or excitement together*, *worked out strategies* (i.e. when players talk aloud about solving a shared challenge), and *helping each other* (i.e. corresponds with helping events in gameplay or with the tool).

Researchers have conducted studies on collaboration and team dynamics within massively multiplayer online roleplaying games (MMORPGs), such as World of Warcraft (WoW) (Chen, 2009; Huang, Bennett & Contractor, 2013; Nardi & Harris, 2006). Given that WoW is the most popular MMORPG globally with more than 12 million users, and the game is accessible in several languages, more relevant to the present research are studies specifically examining player collaboration and language learning (Rama et al., 2012; Thorne, 2008; Thorne, Black & Sykes, 2009). Players' progress within WoW by building skills and completing quests, as well as by collecting or creating objects, to then sell or trade for other goods and services. This requires players to communicate and negotiate with non-player characters (NPCs), as well as with other players online. In regards to digital gaming and L2 learning, Reinhardt and Thorne (2016) state:

The language use in, around, and about games has increased in quantity, quality, and diversity, as game playing has become a truly global, interactive, multiplayer, and often multilingual practice. As increasing numbers of L2 learners play digital games outside the

classroom, and games are produced in an increasing variety of game genres and languages, it has become easier to imagine digital games as authentic, consequential, and widely applicable L2 learning resources (416).

Players interviewed for Thorne, Black and Sykes' (2009) study indicated that social dimension and collaboration were some of the most favourable aspects of the game. These prior aspects are not only limited to in-game play, but also take place before and after gameplay (for example in Wikis) resulting in several empirical studies analyzing these online communities (Ryu, 2013; Thorne, Black & Sykes, 2009). One such study found that participants acquired the majority of their language skills in the collaborative online communities outside of the game itself (Ryu, 2013). Ryu (2013) explains that through the game, players discover a wide variety of online communities, such as online forums or Wikis, in order to discuss strategies with other players to help them overcome specific game challenges. In a similar vein, Vazquez-Calvo et al.'s (2019) research entailed a case study analysis of the fan practice of translating gaming content, and the subsequent collaborative online practices. Findings showed that collaborative L2 learning occurred through peer-to-peer feedback in the online community, and that both the individual that translated the content, as well as the other fans reading the content and playing the games became self-directed language co-learners.

Sundqvist's (2019) study examined the potential of digital games for L2 learning with students aged 15-16 participating in the research. Several datasets were used; data was collected for Sample A (1069 participants) by a questionnaire, and productive and vocabulary level tests. Data from Sample B (16 participants) was collected by the same questionnaire, the National test essay, and student interviews. Sundqvist used game preference groups to examine the relationship between L2 learning and the types of games the students played. Findings suggested that

participants who engaged mostly in multi-player games and MMO games scored higher on the vocabulary test than those playing single player games or no games at all. These findings are not necessarily surprising given the high level of interaction in the TL during gameplay of these types of games. However, the multiple regression analysis showed the most important factor appeared to be the amount of time the students spent playing games, highlighting the significance of time on task for learning L2 vocabulary.

Thorne's (2008) research entailed an experimental case study on WoW examining learner interactions of two gamers from different countries (one from the United States and the other from the Ukraine). Chat transcript analysis illustrated the participants' engagement in collaborative target language discussion throughout their in-game interactions. Findings indicated that the gamers exhibited behaviours relating to autonomous and exploratory learning, and their negotiation of meaning included requests for help, comprehension checks, and corrective feedback. Research on digital games and collaborative language learning highlight the potential of online gaming for L2 learning, as well as the importance of documenting player interactions (for example chat transcript analysis in Thorne's [2008] study). The present research pertains to gamifying L2 learning, and not the use of vernacular gaming for language learning; however, researchers and instructors can draw on this previous work for the development and analysis of their gamified systems, given that similar learner/player interactions, collaborative patterns, and negotiation of meaning may emerge during playtesting.

2.4 Mobile gameful L2 collaborative learning

Although not as mature as research on collaborative gaming of vernacular games for language learning, the emerging studies on mobile collaborative language learning are also pertinent for the present research. Kukulska-Hulme and Viberg's (2018) recent review highlights the current research trends on mobile collaborative language learning:

- learner agency and self-direction;
- learners' construction of knowledge;
- authentic communication and the integration of language skills;
- problem-solving and game-playing as popular approaches in task design;
- a desire to facilitate learning in and across multiple contexts and beyond the classroom (215).

The broader above mentioned research trends, while encompassing mobile language learning as a whole, nonetheless mirror those of mobile gamified language learning tools, focusing on learner choice, authentic contexts, and collaborative problem solving outside the traditional classroom. Additionally, researchers have analysed game-based mobile applications focusing on the ways in which collaborative gameplay tasks may lead to language learning gains (Hwang et al. 2016; Wong & Hsu, 2016; Wong et al., 2013). For example, Wong et al. (2013) developed *Chinese-PP* a Chinese character mobile game with distributed resources in order that students would need to negotiate and collaborate to meet game objectives. Fifteen primary students (3rd grade) learning Chinese as a second language participated in the design-based research study. The study entailed a qualitative analysis of video gameplay data and focus group interviews to identify dynamic emerging collaborative and competitive patterns, as well as the strategies students used between the two grouping game modes (i.e. single group mode and multi group mode). Findings supported learning gains, and all three levels of learners (low-high) showed similar frequency of “student-

leadership” when proposing characters to teammates in the last three of the six sessions. Observed interactions included negotiation, peer coaching and discussions regarding alterations of the characters with students employing varying strategies to optimize their winning chances in the two different modes. Wong et al. (2013) attest that vital elements of the students’ success included “the joyfulness of game playing, and the individual students’ resulting self-esteem from both winning the game and assisting their peers” (185). Additionally, the authors state that a key element of achieving effective collaboration during gameplay was the intentional game design of distributed resources.

Similarly, Hwang et al.’s (2016) experimental design-based research employed collaborative gameplay design. Participants in the study were 40 English foreign language female high-school students with 20 participants in the control group (paper and pen game system) and 20 in the experimental group (digital game-based system). Findings supported that the students employing the digital game-based jigsaw vocabulary system significantly outperformed the control group participants in the verbal post-test. However, in the listening post-test both groups scored similarly. Limitations of the study include only female participants and a relatively small sample group. Additionally, a design limitation emerged during the study. The experimental group participants were dispersed when listening to their peers recorded audio files (which also included viewing the student made game cards for the jigsaw digital game), and not face-to-face like the control group. Although students creating their own digital game cards supports the contextual learning element the designers sought with the students employing images from their surroundings and everyday lives, it did not supply enough context for the students listening to the audio recordings associated with the game card images, and in result they had great difficulty

understanding what was said. As stated by Kukulska-Hulme and Viberg (2018), “we still know little about the processes and steps that are essential for mobile learning design. This should be examined further, especially in terms of collaborative mobile learning” (216). Therefore, although research supports collaborative mobile language learning affordances, there is a need for continued research on these learning environments, and more specifically on their development.

2.5 Mobile AR and collaborative language learning

In regards to AR systems specifically for language learning research is still emerging; however, many of these focus on approaches other than collaboration, and are not necessarily gamified. Additionally, regarding mobile AR for learning Pegrum (2019) discusses the range of possible designs with students’ roles varying from passive observers to active learners. For example, Liu et al. (2014, 2018) developed an AR learning environment in a fitness centre to augment English fitness-related reading comprehension. Users scanned QR codes to access dialogues (with written captions) between native English speakers, providing information about the fitness machines as well as their proper use. In another exploratory case study, Liu and Tsai’s (2013) employed AR for a L2 writing task. The AR system was designed to supply information in the target language at real-world locations (such as vocabulary and descriptions of buildings and scenic sites), with students later describing in an essay the locations they had visited. These two studies are on the passive end of the spectrum, as Pegrum (2019) describes “students’ devices might serve mainly as lenses to make the invisible visible, helping them to notice and perhaps record learning opportunities around them” (212). Additionally, the prior two examples of AR use are not gamified

learning environments, but systems that simply employ AR to supplement the real-world environment with relevant information.

Towards the other end of Pegrum's (2019) described continuum, the present research is motivated by design in which "students might be prompted to interact with their settings and try out their developing knowledge and skills; or to collaborate with peers and others as they engage in problem-solving" (212). Therefore, more relevant to the present research is Holden and Sykes' (2011) case study, which explored place-based language learning and examined the affordances, as well as the complexities of employing mobile games for L2 learning. Their AR L2 game *Mentira* is one of the first such games developed for language learning. *Mentira* entails a detailed fictitious murder mystery integrated into real-world locations in a local Spanish speaking neighbourhood, which required players to collaborate in order to solve the mystery. Preliminary findings indicated that students found the place-based component of the game provided a contextual and meaningful learning experience. Observational and interview data also indicated the students' interest in actively participating in their language learning, achieved by available choices made during gameplay or by providing students the opportunity to participate in game development. The collaborative nature of gameplay was not broached in this study.

Holden and Sykes' research, and the lack of an AR gamified system for FL2 inspired the creation of *Explorez* and Perry's (2015) research. The present research builds on insights gained from Perry's (2015) study, in which the author developed and implemented the *Explorez* prototype learning-tool for first-year university level French students in order to bridge the gap between gaming and education through quest-based learning and AR. AR allows for the integration of computer-generated images and media in physical space. Using GPS, *Explorez* transforms the

university campus into a virtual francophone world where students interact with characters, items, and media as they improve their French language skills and discover their campus.

In the case study that evaluated the participants' assessments of the tool and that of their learning experience, findings indicated that students found the gamified system to be intrinsically and extrinsically motivating. Thus, supporting the potential of gamifying FL2 as a means to engage and motivate learners. Furthermore, the students' efforts and enthusiasm when interacting with the system and each other were encouraging. They made great efforts to speak in French, as they maneuvered the interface of ARIS¹, exploring the quest log, their game inventory, and the game map, collaborating to decide their next step in the game. At times this resulted in a sign language form of communication when they lacked a vocabulary word in French. However, rarely did the students employ the available online tools to look up vocabulary. What did result was a sociocultural learning effect, with many examples of collaboration between the players: a more advanced student helped the lesser-advanced one navigate the system or quest and supplied the necessary word or information. This collaborative aspect merits further study.

Additionally, to appeal to the largest demographic possible, *Explorez* includes a diverse range of game-elements. In Perry's (2015) study, the students were asked to rate four such elements as learning motivators regarding their experience with *Explorez*: creating avatars, completing quests, collecting badges, and collaborating with teammates. Students chose a response on a 5-point Likert scale; 5 indicated the element was "positive - it motivated me in my learning"

¹ ARIS is an open-source platform for creating and playing augmented reality games and interactive stories.

whereas 1 indicated, “negative - it was de-motivating”. On the 5-point Likert scale the participants mean rating of creating avatars was 3.5, the mean rating of collecting badges was 4.4, completing quests, and collaborating with teammates were both ranked with a mean of 4.5. This study consisted of a small test group and the results do not represent FL2 learners as a whole. However, the results supported prior studies, which demonstrate game-based mechanics can be positive motivators for learners. Additionally, these findings indicated that on average the test group found the intrinsic learning motivators of quest completion and *collaborating with teammates*, to be *Explorez*’s more relevant game mechanics. This further supports the present research goal.

Since the above-mentioned study, research on collaborative AR language learning has begun to emerge. Given the affordances of AR use within real-world contexts, much of the current research draws on contextual or situated learning theory (Pegrum, 2019). Berns et al.’s (2016) research draws on contextual learning and entails a communicative approach. The authors study consists of a hybrid game-based app *VocabTrainerAI* which begins with individual learning tasks, to then employ the learned vocabulary in a collaborative murder mystery role-playing AR game. The 4-week study consisted of 104 German language students at a Spanish University. One of the objectives was to offer students the opportunity for real-life-like communication with their peers in the target language. Qualitative data from a TAM (Technology Acceptance Model) survey and focus group interviews supported the app motivated learners, added value and perceived usefulness to meet the student’s language learning needs. Quantitative data from pre and post-test writing tasks indicated positive learning gains. The murder-mystery portion of the app allowed students to communicate and negotiate with their peers, hence building their skills of effective written communication in the target language. In regards to limitations, the authors discuss how there is

an increasing focus on independent learning at the expense of face-to-face interaction for language learners, and then interestingly chose a dispersed gameplay design with students in different physical locations using text-based interactions with their peers instead of a face-to-face model. Additionally, collaboration is only mentioned as part of the design process of the learning tool, and is not the focus of the analysis. The study instead investigates the students written learning gains regarding the collaborative gameplay necessary to solve the murder mystery.

In regard to collaborative language learning, it could be argued that there is more value and potential for language learning AR systems that employ the face-to-face option with students playing in teams as they explore the gameful environment. For example, several studies employed video data of *ChronoOps* team gameplay for their examination of language acquisition, and the significance of place-based learning in AR games (Hellermann et al. 2017; Sydorenko et al. 2019; Thorne et al., 2015; Thorne & Hellermann, 2017). *ChronoOps* is an ARIS AR mobile game developed at Portland State University and is available in several languages (English, French, German, Japanese, Spanish, and Hungarian). Students play the role of a time traveling agent from a future that is devastated environmentally. In small groups players seek out 5 designated sustainability projects and green technologies on campus. The objective is to make video reports on the advantages and disadvantages of these projects and technologies, in order to inform and potentially save their condemned future. Thorne and Hellermann's (2017) descriptive analysis on *ChronoOps* examined video data of small group interactions during gameplay, and the ways in which the students drew from their immediate environment to co-construct their response to the task on hand. Findings reported three emerging themes; during wayfinding as students figured out the next gameplay location and how to get there; pre-planning discussions before making the

report; and both physical and verbal references to the immediate surroundings while making the video report. Thorne and Hellermann's (2017) conference proceedings paper provided two excerpts to support their findings. One from the Hungarian team (duration not specified) and the other from the English team (4 min 45s in duration). Unfortunately, there is no mention if the discussed incidences occurred more than once for the teams documented, nor if they were noted in other teams during the analysis of the videos. The paper states that during the oral presentation another two excerpts will be shown and the authors "will describe the findings and salient points in more general and less technical terms since key analytic features are readily visible, and more easily explained, following a viewing of the video data" (5). This is a limitation for those who only have access to the written document. Furthermore, it would also be useful to know the duration of the interventions. The authors state the corpus is 18 hours of video recordings of player interactions, with a group for each version (language) of the game (therefore 5 groups). Groups consisted of three players of different language levels with two participants wearing head mounted cameras, and then the groups interactions were captured by a third camera. The reader can only infer that the interventions were approximately 1.2 hours each. The small test group of 15 participants is also a limitation.

In two additional studies, the researchers employed conversational analysis to examine collaborative patterns during gameplay of *ChronoOps* (Hellermann et al., 2017; Sydorenko et al., 2019). Hellermann et al.'s (2017) close analysis of one team of 3 participants described the complex interactions pertaining to collaborative reading aloud during gameplay. Findings showed that reading game text aloud resulted in diverse interactional practices, such as co-reading, turn taking, and paraphrasing. Additionally, the authors state that in contexts of collaborative action,

reading can trigger and merge both social and embodied practices when students are wayfinding, seeking clarification or additional information during gameplay. Similarly, Sydorenko et al. (2019) examined the collaborative dialogue of four teams of three students each (2 English language learners, one expert of English) during gameplay of *ChronoOps*. The corpus consisted of 16 hours of video recordings with 10 teams of 3 participants each, again 3 cameras per group. This study also employed conversational analysis, as well as drawing from sociocultural theory, and focused on LRE (language related episode) patterns and the ways in which they occur. The initiation (assistance or clarification requests), resolution, and subsequent use of lexical items during gameplay were documented and analysed. Findings supported the place-based activity offered opportunities for language exploration, situational driven vocabulary learning, and collaborative co-construction of meaning. However, only lexical items were observed, and the complete lack of form focused LREs was noted by the authors. A possible offered reasoning was that students were intent on progressing the gameplay and therefore let pass form-focused errors as they did not interfere with comprehension. In both above-mentioned studies, once again the authors do not indicate the duration of the interventions. Given Sydorenko et al.'s (2019) corpus and the number of teams and cameras, the reader may infer that the average duration for each group is approximately 32 minutes. This represents less than half the deduced duration of Thorne and Hellermann's (2017) gameplay duration. Understandably, it would appear that having an expert language speaker on the team cuts gameplay time down substantially. Providing additional information, such as gameplay duration, as well as design and development details would be useful for readers seeking resources to develop similar tools. Sydorenko et al. (2019) do however state that the research is ongoing.

Other than Perry's (2015) thesis, Zheng et al.'s (2018) study is the only resource discovered during the present research review that supplied a detailed account of the design and development stages of the AR language tool. Zheng et al.'s (2018) research analysed the ARIS AR system, Guardians of the Mo'o, focusing on an ecological view perspective, and the development of community during gameplay. Five groups of English second language learners at the University of Hawai'i at Ma'noa participated in the study with each group accompanied by one or two researchers for technical assistance and to video record student gameplay and interactions. Findings from a close analysis of one group of students during gameplay showed how place played a role in regards to the learner's efforts for meaning making, collaboration, and embodied action. The authors also noted that gameplay observations supported that participants created a sense of community not only with their peers, but in one instance the community extended to also include a librarian with whom students were interacting and asking questions. Additionally, Zheng et al. (2018) provided a detailed account of interactions during a gameplay event that "showed that languaging² to coordinate events as a way of learning can be evidenced in the successful problem solving" (55). Documenting and analysing collaborative languaging events is therefore another means to potentially show language learning during gameplay using AR learning tools. As stated previously, the process and the steps necessary to create these learning systems is a very necessary element of the research. The authors well documented this information for the reader and included

² Swain (2006) describes languaging as a "means to mediate cognition" (96) and "a process of making meaning and shaping knowledge and experience through language" (98).

game objectives, theory employed for design, development process, as well as detailing the necessary second iteration changes after a pilot study. Given that the two prior mentioned studies were the only research detailing the design and development process, it is pertinent to mention that all the above-mentioned ARIS gamified experiences can be accessed to play via the app, thereby at a minimal level allowing developers and researchers to see the employed game mechanics and narratives to assist in the development of such a tool. Additionally, the Place- and Experience-based Database for Language Learning (PEBLL) which is a resource from the Centre for Applied Second Language Studies at the University of Oregon provides information on additional L2 AR gamified systems for one to explore.

All of the prior AR L2 studies mainly provide details regarding student interactions with each other and/or game content at the designated locations, and the majority do not cover what happens when players are walking from one location to the next during gameplay (see Thorne et al., 2015 for the exception, which provides micro-interactional analyses of movement between locations in AR experience). Do the players continue to use the target language when travelling between locations? To further the research domain, it would be useful to also include the percentage of time students remain on task during gameplay, as well as the percentage of gameplay students employ the target language to provide additional insight on the potential of these learning tools. As Reinhardt (2019) highlights, research on gamified L2 learning is still limited and there is much to be explored. The present research will contribute to this body of knowledge by addressing the previous stated questions, as well as examining the collaborative patterns of students during gameplay of AR learning tools; specifically, analyzing learners' social regulation and content processing during gameplay with the adaptation of Volet et al.'s (2009) CL framework.

2.6 A Framework for the analysis of collaborative learning

Volet et al.'s (2009) research examined how high-level co-regulation during collaborative learning emerges and is subsequently sustained. The study employed video footage of three groups of veterinary science students during two meetings as they worked on a group assignment in the analysis of a clinical case. A framework was developed for the analysis of the students socially-regulated learning and combined the concepts of social regulation and content processing. The potential social regulation within a group of learners was represented with a continuum from individual regulation within a group of learners to co-regulation as a group. The learner's potential content processing continuum was represented with low level content processing on one end (such as acquiring knowledge), to high level content processing (constructing meaning) on the other. Volet et al. first coded the verbal interactions of the students into two main categories: processing the clinical case and other matters (such as task-related matters and organization). Next, content processing was further coded into four categories: low-level individual regulation, low-level co-regulation, high-level individual regulation, and high-level co-regulation. The data was examined three ways: the focus of interactions during the meetings, patterns regarding the emergence of high-level co-regulation, and contributing factors to sustained high-level co-regulation. Volet et al.'s results partially supported their expectation that the second meeting would allow for increased opportunities of collaborative learning, given that students would have made considerable progress regarding their knowledge of the case study. Additionally, findings showed that the emergence of high-level co-regulatory episodes were most often initiated by a question or an explanatory statement or summary. The findings also identified four possible factors to a group sustaining

high-level co-regulation: asking questions, tentativeness of explanations, background knowledge, and shared positive emotions. The authors invited other scholars to continue the research on CL and adapt their framework to other learning contexts.

2.7 Theoretical framework

The theoretical framework for the present design-based research draws on several learning theories, as well as gaming research for the design and development stages of the next iteration of the learning tools. As stated previously this domain is incredibly interdisciplinary, and each stage of the design-based research draws on a combination of different theories which also serve to guide the interpretation of data analysis for this study. This section will focus on the following: self-determination theory, situated cognition, as well as sociocultural and gaming research. These theories guided the design and development of the tools, the design of the research, helped frame the research questions and were also a means to interpret the data.

2.7.1 Self-determination theory

A primary goal in gamification is to unite extrinsic and intrinsic learning motivators (Werbach & Hunter, 2012). To appeal to the largest demographic possible, the next iteration of the tool *Explorez 2.0* includes a diverse range of elements. The extrinsic motivators of points and badges of accomplishment will appeal to certain players, while others will be drawn to intrinsic learning motivators. Vital to successful gamified learning-tools is self-determination theory, which demonstrates that intrinsically motivating activities must include three elements: competence, autonomy, and relatedness (Kapp, 2012). *Competence* is the sense of accomplishment gained

through overcoming obstacles; challenges within *Explorez 2.0* become more complex and therefore more rewarding once achieved. To experience *autonomy*, individuals need to feel they are in control, and making meaningful choices. *Explorez 2.0* is designed to allow learners to decide which quests and challenges to pursue, thus allowing them to choose their own learning path. *Relatedness* is the feeling that the activity is connected to something beyond you: being a team player or doing activities with friends and is incorporated in *Explorez 2.0* through group quests and challenges, as well as the inclusion of the collaborative gaming patterns.

2.7.2 Situated learning theory

As mentioned previously, the use of augmented realities within a pedagogical context often draws on situated learning theory (Pegrum, 2019) and is therefore significant to the present research. The foundation of situated learning is associated with Lave's (1988) research, and the concept was initially proposed by Lave and Wenger (1991). Lave and Wagner (1991) affirm that learning is fundamentally social, naturally embedded within everyday activity, culture, and context, and is often unintentional. Their work also highlights interactions between *newcomers* and *more knowledgeable others*, describing a dynamic learning process which entails guidance, assistance, and co-construction of knowledge (Lave & Wagner, 1991).

Situated learning theory posits the significance of authentic contexts for learning as well as communities of practice (Dunleavy & Dede, 2014); therefore, developing authentic collaborative learning environments via AR is a pertinent option regarding a required shift in pedagogy for FL2 learning. Herrington, Oliver and Reeves (2002) define authentic activities as “tasks that have real world relevance and utility, that integrate across the curriculum, that provide appropriate levels of

complexity, and that allow students to select appropriate levels of difficulty or involvement” (62). This reflects the aims of gamified learning, and in the context of language learning, highlights a need to add meaning to otherwise decontextualized facts and skills. Dunleavy and Dede (2014) attest that knowledge is acquired best in its natural setting, and learning entails mastering authentic tasks in a meaningful, realistic situation. Thorne and Hellermann (2017) highlight certain shared objectives of existing L2 AR games:

such as to increase engagement in the language learning process by moving students and language learning experiences out of the classroom and into the world and to provide *in situ* prompts for communication and language use in situations of contextual relevance to the topical activity at hand (9).

This mirrors the concept of situated cognition which suggests learning is naturally tied to authentic activities, context, and culture (Brown, Collins & Duguid 1989). However, in the second language classroom, this can be a challenging task for the instructor. Holden and Sykes (2011) attest that a large divergence exists between the authentic foreign communities and cultures, in contrast to the L2 classroom environment.

Holden and Sykes (2011) addressed this challenge by incorporating AR into an authentic Spanish speaking neighbourhood for their L2 research, engaging the students in local contexts. Although the prior example may be considered an ideal use of AR for L2, given the opportunity for students to engage with expert speakers of the target language, this is often not an option for instructors. Fortunately, AR for L2 learning is also a means to creating virtual language learning environments, and gain insight as to whether or not learners find this a relevant experience. As detailed previously (see section 2.5 *Mobile AR and collaborative language learning*) research pertaining to AR and language learning within these virtual language environments is emerging

(for example Perry, 2015; Sydorenko et al., 2019; Zheng et al., 2018). Perry's (2015) findings supported that students found speaking French in real world locations (although only virtually French) aided in their understanding of how they may apply their French, subsequently giving more meaning to their learning. One of the objectives for the present research was to provide a contextual and immersive learning experience for the students. Therefore, both gamified systems were designed to include gaming tasks that incorporated real-world locations with contextual relevant content that also reflected the course learning content, such as food, cinema, music, and student life.

2.7.3 Sociocultural theory

Given that the focus of this study is collaborative language learning, this research also draws on sociocultural theory. Similar to Perry's (2015) study, a large portion of AR L2 research draws on sociocultural theories, focusing on language learners' co-construction of knowledge (Pegrum 2019). Sociocultural theory within the domain of CALL (computer assisted language learning) focuses on the social nature of language learning and emphasizes learner interactions as a principal learning force (see Vygotsky, 1986). Central to this perspective is the notion of mediation, a process involving social interaction and the use of tools to facilitate higher mental activities and skills (Lantolf & Thorne, 2006). In regards to CALL research, mediating tools include both the language and the technology employed (i.e computer, software, smartphone, gaming platform) for the learning activities. Learners develop language skills by means of interacting with more knowledgeable peers and the mediating tools. This in turn is linked to the concept of the zone of proximal development (ZDP), defined by Vygotsky (1978) as "the distance between the learner's

actual developmental level as determined by independent problem-solving and the level of potential development as determined by problem-solving under adult guidance or in collaboration with more capable peers” (86). Therefore, by means of collaboration learners construct new concepts, ideas or hypotheses, which in turn can produce meaning making. Thus, development within the ZDP is understood as the difference between what a learner can accomplish individually, and what they can achieve with the mediation of a peer, instructor and/or learning tool (Lantolf & Thorne, 2006).

2.7.4 Gaming research

Research within the domain of video games is imperative regarding the design and development stages of the next iteration of the learning tools. According to Huizenga et al. (2009) many studies pertaining to games and motivation draw from the work of Lepper and Malone (1987) which propose seven gaming factors to promote intrinsic motivation: challenge, curiosity, control, fantasy, competition, cooperation and recognition (2). Amy Jo Kim’s social engagement verbs describing players—*express*³, *explore*, *compete*, and *collaborate*—parallel several of these factors, and are also beneficial when addressing engagement of students (Kim, 2011). In fact, the social engagement verb describing a single player will vary depending on the task at hand, hence why a successful gamified system includes a variety of options.

³ Amy Jo Kim revised Bartle's Player Types Model, and replaced the "killer" type with “express”. Her recommended “express” verbs to consider when designing a gamified experience are choose, create, build, design, and customize.

In regards to *Explorez 2.0* those who like to *express* will create their own learning experience when they choose quests and the subsequent activities in which they will participate. The *explore* element is achieved through the game narrative, and different quests and challenges, as well as physically exploring the University campus. Challenges involve, but are not limited to watching videos, reading text, answering questions, taking pictures and exploring locations. The *collaborate* aspect is addressed when students work together in teams while playing the game, and potentially aid each other within the context of the game, language challenges and/or using the tool.

In addition to *Explorez 2.0*, a French version of the team-building AR game *UVic Normal Campus Tour*, (*VdeUVic*) is part of the current research. *VdeUVic*'s game design parallels the parameters from Nasir et al.'s (2015) study, geared towards the analysis of an icebreaker game drawing on nine parameters of multi-player video games from prior research:

1. Complexity (intricacy, objectives, variety of choices, player control over outcomes): The game should incorporate a moderate level of complexity to mentally stimulate the participants.
2. User interface (both software and hardware): The interface should be easy to use so that people with varying levels of video game experience can quickly adapt to the game.
3. Difficulty (skill, precision required, likelihood of failure in carrying out a task): The game should be moderately easy so as to avoid frustration and allow steady team progress.
4. Subject Matter: (context of the story [if any], themes used, general game content): Although not a critical to the design having a game with a theme that appeals to a variety of people would be useful for encouraging everyone to participate.
5. Participation: A means to enforce collaboration by encouraging balanced participation.
6. Unique Roles: Incorporate the aspect of unique roles into the game itself and have different players perform different, yet individually important functions.
7. Social Interaction: The game should encourage social interaction by creating the need for players to talk to one another in order to figure out how to overcome various obstacles and assist struggling teammates, as is desirable in real collaborative work.
8. Collaborative patterns (complementary roles, synergies between player abilities, shared goals, limited group resources): The game should incorporate a few of these basic patterns.

9. Synchronicity (simultaneity with which individual players participate in a game): Based on synchronicity, games can be classified into three distinct types: 1) Concurrent (same time in parallel), 2) Synchronous (same time taking turns), and 3) Asynchronous (different times). The game should support concurrent play, to ensure continuous engagement of each player in the same amount of time (132).

All of the above parameters, except unique roles were considered and implemented in both *Explorez 2.0* and *VdeUVic*. However, since collaboration is the focus of the present study, the most pertinent parameters are participation, social interaction, and collaborative patterns.

This chapter detailed the current state of research regarding AR and mobile learning, collaboration in digital games, mobile gameful L2 collaborative learning and mobile AR and collaborative language learning. Next, the theoretical framework was detailed, which entailed self-determination theory, situated learning theory, sociocultural theory, and gaming research. The following chapter explains in detail the steps and process of the development of the next iteration(s) of both language learning tools employed during the present research, before moving on to the methodology of the study.

Chapter 3. Methodology

This research analyses collaborative L2 in gamified environments, and specifically examines affordances and limitations of mobile gamified language systems and augmented reality in supporting collaborative second language learning. The research questions to explore the affordances and limitations of these technologies are:

1. What are the participants' perceptions of their learning experience?
2. Which elements do they identify as useful or not for language acquisition?
3. How do they collaborate in order to complete the tasks?
4. In what ways do L2 learners socially regulate and process content during gameplay?
5. What are the characteristics of language learners' group interactions in a gamified augmented reality environment?

In order to address the research questions, Peffers et al.'s (2007) design science framework, a form of design-based research (Design-Based Research Collective, 2003), was employed. This framework entails an iterative process in which each stage produces output that becomes input for the next stage. This methodology consists of six activities to progress through the research process:

1. Problem identification and motivation: define the specific research problem and justify the value of a solution.
2. Definition of solution objectives: infer the objectives of a solution from the problem definition and knowledge of what is possible and feasible.
3. Design and development: create the artifact and include knowledge of theory that can be brought to bear in a solution.
4. Demonstration of artifact usage: demonstrate the use of the artifact to solve one or more instances of the problem.
5. Observation and measurement: observe and measure how well the artefact supports a solution to the problem.
6. Diffusion: share the resulting knowledge. (132)

Although created for Information Systems, this methodology lends itself well to other research domains. Regarding educational research and the need to make improvements in this domain, Reeves (2006) proposes, “that progress in improving teaching and learning through technology may be accomplished using design research as an alternative model for inquiry” (24). Additionally, within the context of educational design research, Reeves, Herrington and Oliver (2005) parallel five of Peffers et al.’s (2007) activities when describing the benefits of Design Science:

One of the primary advantages of design research is that it requires practitioners and researchers to collaborate in the identification of real teaching and learning problems, the creation of prototype solutions based on existing design principles, and the testing and refinement of both the prototype solutions and the design principles until satisfactory outcomes have been reached by all concerned (25).

As seen in Figure 1, *the problem* the present research addressed was a gap in the research on gamified systems supporting L2 collaborative learning. Next, to study the limits and affordances of these technologies, *the solution objective* required a working gamified system for students to playtest. The DBR process enabled the design and iterative development of the gamified systems. I examined data from playtesting to discern what worked and what did not work

to make improvements to the artifacts. The improved tools were then tested with the next cohort of students. I completed this process three times, developing a different iteration of the tools for each cohort of students.

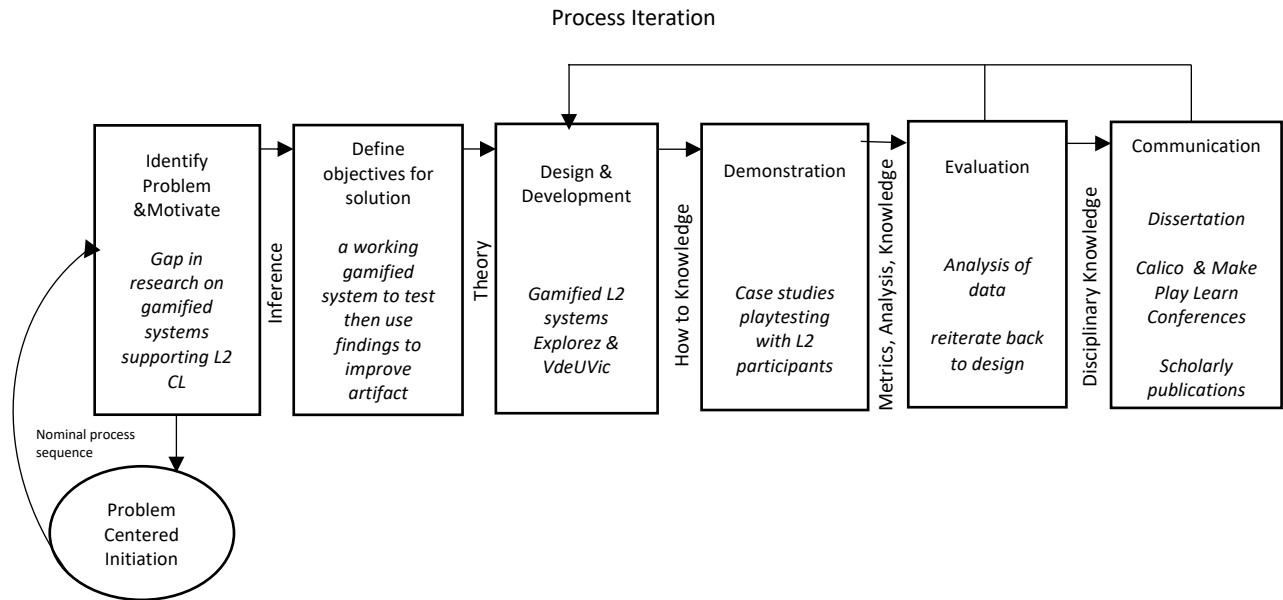


Figure 1. Design Science Research Methodology Process

As mentioned previously, the first step of the present research was to recycle the data and feedback from student testing from Perry’s (2015) study, and the pilot testing of *UNCT* into the next *design and development* stages of the AR tools (see section 3.1 *Gamified Learning Systems*). The theoretical framework for this DBR drew on several learning theories, as well as gaming research for the design and development stages. First, a well-developed gamified system includes both extrinsic and intrinsic learning motivators (Werbach & Hunter, 2012). Extrinsic motivators, such as points and badges of accomplishment appeal to some players, while others are drawn to intrinsic learning motivators. Hence, the tools were developed to include a diverse range of elements in order to appeal to the largest demographic possible.

Next, the design process was also informed by *self-determination theory*, which posits that intrinsically motivating activities require three elements: competence, autonomy, and relatedness. Additionally, informed by *situated learning theory* an aim of this research was a contextual and immersive learning experience for the students. Therefore, both gamified systems were designed to incorporate real-world locations with contextual relevant content that also reflected the course learning content. Finally, well-developed gamified systems should include “the spirit of a game” and “gamefulness” (Takahashi, 2011). Therefore, informed by *gaming research*, Nasir et al.’s (2015) nine parameters of multi-player video games were also included in the design and development of the learning tools (see section 2.7 for a more detailed account of the theoretical framework). The design of the tools impacts the CL potential, thus justifying the first two RQs concerning player/learner experience and identifying the specific gaming elements that are motivating and useful for L2 learning.

To *demonstrate the use of the artifacts* in relation to the research goal, I embarked on case study analyses, recruiting three cohorts of FL2 participants to playtest the gamified learning systems. Ninety-seven students played *VdeUVic*, 78 of the 97 students also played *Explorez*, and 58 students chose to participate in the study. The research used a mixed method of data collection, so as to permit a comprehensive study focusing in particular on interactions of *learner to instrument*, and *learner to learner*— while engaging in technology-mediated tasks. As McGrath (1995) states “[i]f you use multiple methods, carefully picked to have different strengths and weaknesses, the methods can add strength to one another by offsetting each other’s weaknesses” (17). This highlights the strength of triangulation, which includes using several research methods

to validate the data by cross verification of multiple sources. Therefore, qualitative and quantitative data were gathered by means of questionnaires (pre and post-play), focus groups/interviews and video recordings of the sessions for analysis of the students' interactions with the systems, as well as each other during playtesting. This research was informed by sociocultural theory and the social nature of language learning, emphasizing learner interactions as a principal learning force. Additionally, the combined theoretical framework not only contributed to the design and development stages, but also guided the design of the research, helped frame the research questions as well as interpret the data.

To *evaluate* the impact of the artefacts, I compiled and analysed data from testing group 1 (video data, questionnaires, interviews) and then returned to the design and development stage to incorporate the findings. I applied the same process to group 2, reiterating back in the research process to integrate findings. However, time constraints impeded the extent of group 2's data analysis due to overlapping testing sessions of groups 2 and 3; therefore, it was not as comprehensive as the previous analysis for this stage of the research. However, once group 3 testing was complete, I compiled the data from all three groups for the necessary analysis to address the research questions.

RQ3 (concerning how students collaborated to complete the tasks) entailed the analysis of the transcribed video recordings, which had been coded for language collaboration, technical collaboration, and gameplay collaboration. The findings for this analysis suggested the potential of the AR gamified environments to facilitate high levels of interaction and collaboration. The findings also illustrated distinct types of learner interactions amongst teams during gameplay.

A preliminary analysis of group 3's data showed that these students relied more so on the accompanying language expert (researcher/TA) for game comprehension than each other. Since the present research sought a close analysis of L2 students' collaborative learning, the data coding and analysis for RQ4 and RQ5 was restricted to groups 1 and 2. These two cohorts of students had either no accompanying language expert or limited interference from the accompanying researcher/TA. The transcribed video recordings were coded for high-level content-processing episodes (individual or co-regulation) and low-level content-processing episodes (individual or co-regulation) to address RQ4 regarding how L2 learners socially regulate and process content during gameplay. The adapted framework was found to be useful in identifying patterns of interaction during gameplay of the AR L2 gamified systems. The analysis showed distinct patterns of collaborative learning across groups and sessions. Additionally, the findings identified patterns in the emergence of learners' high-level co-regulation, as well as factors that assisted students in sustaining engagement of high-level co-regulation during gameplay.

The transcribed video recordings were also coded for duration of gameplay, percentage of time on and off task, lapses of silence, use of an online dictionary, percentage of French vs English spoken during the task, and the number of times two or more group members laughed during gameplay. This data analysis addressed RQ5 concerning the characteristics of language learners' interactions as a group in the AR environment. Findings showed that overall the participants spent the vast majority of time on task, and most of the time processing content. The results of this analysis also highlighted that it is not only students' language abilities that impact their learning experience in these gamified environments, but that competencies in technology and gaming also play a role. Additionally, factors such as group cohesion and positive emotions also impact CL.

The design science framework and hybrid method of data collection and analysis (Nunan, 1992) provided sufficient information to address the research questions. The employed DBR process also correlates with the CSCL method of iterative design, which combines theory and informal observations via case studies in order to improve the artifacts, which mediate the learning and collaboration: “[d]esigners need to conduct microanalyses of collaborative learning with and through technology in order to identify the features of designed artifacts that seem to be correlated with effective learning” (Stahl et al., 2006). The following Table 1 provides a summary of the data collection instruments, procedure, and analysis for each research question.

Table 1. A Summary of the method in the present study

Research Question (RQ)	Instruments	Data Collection Procedures	Data Analysis Procedures
RQ 1 (student's perception of the learning experience)	Post-play questionnaire (Appendix B) & Interview/ focus group (Appendix C)	Online post-play questionnaire emailed the week following playtesting S3. Followed-up by email for participants willing to participate in a semi-directive interview of 10 questions at their convenience.	Descriptive statistics
RQ 2 (elements students identify as useful for language learning)	Post-play questionnaire (Appendix B) & Interview/ focus group (Appendix C)	Online post-play questionnaire emailed the week following playtesting S3. Followed-up by email for participants willing to participate in a semi-directive interview of 10 questions at their convenience.	Descriptive statistics
RQ 3 (how students collaborate to complete tasks)	Video recordings of student gameplay	One team member per group of students wore a GoPro during gameplay to capture player and gameplay interactions	Descriptive statistics of transcribed video recordings coded for. <ul style="list-style-type: none"> • language collaboration • technical collaboration • gameplay collaboration
RQ 4 (how L2 learners socially regulate and process content during gameplay)	Video recordings of student gameplay	One team member per group of students wore a GoPro during gameplay to capture player and gameplay interactions	Descriptive statistics of transcribed video recordings coded for <ul style="list-style-type: none"> • High-level content-processing episodes (individual or co-regulation) • Low-level content-processing episodes (individual or co-regulation)
RQ 5 (how language learners interact as a group in the AR environment)	Video recordings of student gameplay	One team member per group of students wore a GoPro during gameplay to capture player and gameplay interactions	Descriptive statistics of transcribed video recordings coded for <ul style="list-style-type: none"> • duration of gameplay • percentage of time on /off task • lapses of silence • use of an online dictionary • percentage of French vs English spoken during the task • the number of times two or more group members laughed during gameplay

3.1 Gamified learning systems

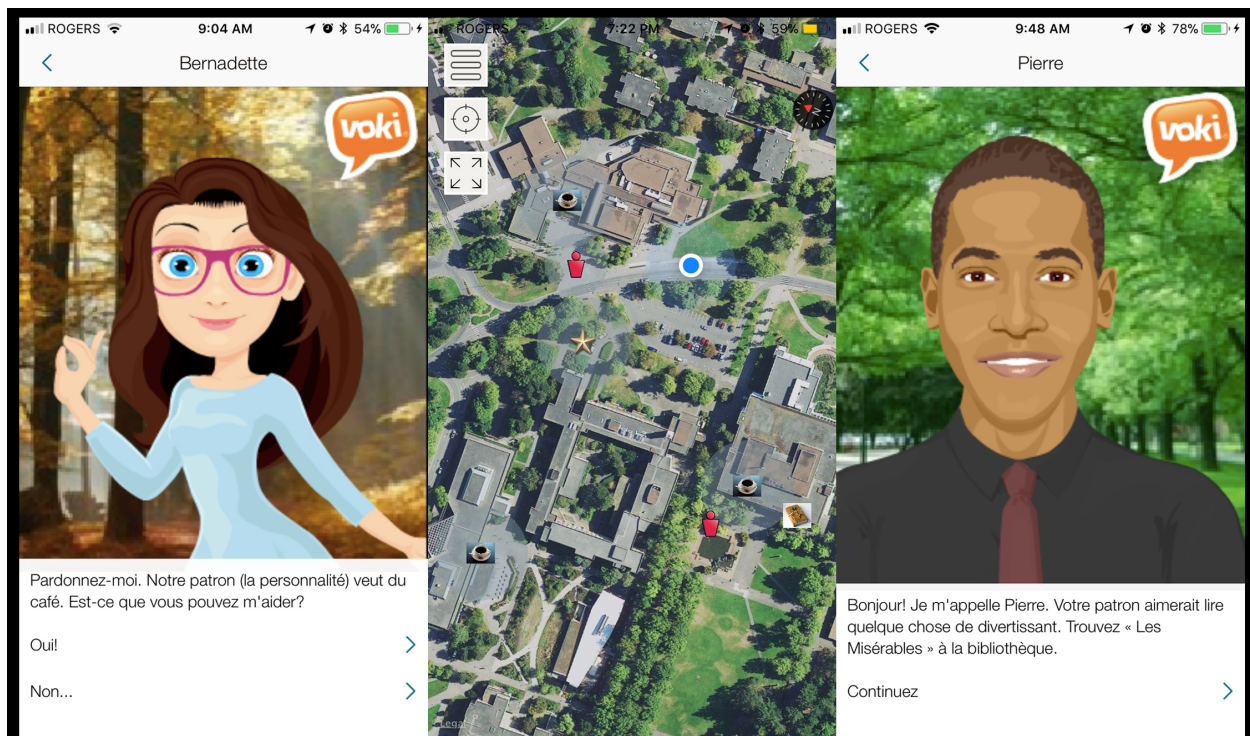
This study builds on Perry's (2015) case study analysis of *Explorez* which focused on the motivation and engagement potential of gamifying L2 learning. The original design of *Explorez* centered around collaboration, but its effect on collaboration was not tested in the study. A first step to the present research was therefore the development of the next iterations of both AR games, *Explorez* and *VdeUVic* incorporating student feedback from previous testing, as well as applying the multi-game parameters mentioned earlier (see section 3.4 *Gaming Research*).

3.1.1 *Explorez*

Explorez is a quest-driven virtual narrative treasure hunt. The overarching gameplay narrative entails a francophone celebrity visiting the University of Victoria, and this individual is seeking an assistant to help them with certain tasks, which includes learning about the campus. At the designated game locations, students interact with non-player characters (NPC) who direct them to certain locations, provide details about the quests (which involve specific tasks) or progress the gameplay narrative. Gameplay interactions take place in the form of written text or audio and video recordings, allowing the learners the opportunity to improve and practice both their written and oral language skills, and therefore benefit from increased language input and output production. Additionally, *Explorez* emphasizes oral production by means of an audio journal. The gamified system consists of three levels with four quests per level and several challenges allowing the learners to choose their own learning path. The quests were designed based on themes studied in the language laboratories of the Fran 160 course at the University of Victoria, such as food, entertainment, music etc. Thus, the gameplay tasks are directly linked to the course content. After

choosing a quest, the players physically go to the instructed location. Players use the map function as a guide and the characters automatically appear on screen when players are close to the location and have fulfilled necessary quest requirements, as illustrated in Figure 2, which show the first two NPCs encountered, and an example of the player map view for the quest “Trouver le bon café”.

Figure 2. Examples of NPCs and map in Explorez 2.0



Note. Left panel –NPC Bernadette “Trouver le bon café” quest, middle panel –player map view, right panel –NPC Pierre “Trouver un livre” quest

I used ARIS (Augmented Reality Interactive Storytelling) for the development of the gamified systems. ARIS is a free, open-source platform for creating AR games and interactive stories for players to experience on iOS devices. The platform is designed to be user-friendly to facilitate availability to a wide range of users and requires no programming knowledge. Using GPS, QR codes, or the AR camera view, ARIS allows the creation of a hybrid world of digital

media superimposed on real-world locations. In this sense AR is defined as “[a] situation in which a real-world context is dynamically overlaid with coherent location or context sensitive virtual information” (Klopfer & Squire, 2008, p. 205). Given that *Explorez* is designed and developed by an individual and not a team of developers as in other AR games, such as *Mentira* and *Chrono Ops*, in order to facilitate the process, I combined online resources within the ARIS platform. A brief description of how each online tool contributed to *Explorez 2.0* follows.

3.1.1.1 YouTube: videos and movie trailers

Two common themes covered in the 100 level oral language labs are francophone music and films. Therefore, the gamified system incorporates these with the inclusion of links accessing YouTube videos and movie trailers. In total eight French music videos representing different genres and artists were employed in the level 3 quest “Critique de musique”. This quest entails the celebrity asking if a music concert at the University theatre is worth attending. Students “attend” the virtual concert and then have the choice of critiquing a song or songs (the quest supplies details and vocabulary specific to this task) or conducting an interview with one of their teammates (the quest supplies example questions they might ask for this task). The YouTube music video “le café” (Oldelaf, 2007) was incorporated into the level 1 quest “Trouver le bon café” with the music video popping up while students walk from the library to the Student Union building (SUB). Additionally, three movie trailers portraying francophone films were also incorporated into the level 2 Quest “Le cinéma” given that I had used these before in language labs for discussion and they had been well received. For this quest students watch the trailers and then share which movie they would recommend and why.

3.1.1.2 FrancoToile

The online tool FrancoToile (francotoile.uvic.ca) was also incorporated, given that it is a digital library of videos consisting of authentic francophones speakers from around the globe. Francotoile's video collection entails a range of different topics and allows the learner to "explore key concepts of the Francophone culture through the testimonials of francophone people who currently live or who have lived in a Francophone environment" (FrancoToile, 2020). The library contains videos from speakers that vary in age, as well as different social, geographic and professional backgrounds (Caws, 2010). I incorporated seven of these videos into the quest "Voyagez" (one of the level 3 quests, the highest level of the system), which invites students to virtually travel and "meet" three different francophones from various regions and make a journal entry describing where they went, who they met, and what they learned about the individual. Videos were selected according to their level of difficulty and the location of origin of the speakers offering a variety of francophone dialects. Additionally, to facilitate user comprehension, every video is accompanied by a transcription in order to assist with cultural and/or linguistic references (Caws, 2010).

3.1.1.3 Voki

Voki (voki.com) is a site for creating talking animated avatars which can then be integrated into a site, emailed, or shared on social media. The site allows users to completely customize their avatar, choosing first a character and then customising their outfit, accessories and background. To make the avatar speak, you can record your voice directly or upload an audio file. Alternatively, you can

type a text which will be voiced by a digital voice (male or female) in your chosen language (French, Chinese, Spanish etc.) out of 30 different languages. The site offers a limited free account or the Voki Classroom Management System (CMS) for instructors. Voki CMS allows instructors to create secured logins for each student, as well as the necessary platform to not only create exercises, but also evaluate them and make comments. The Voki platform was employed to include speaking NPCs for the next iterations of *Explorez*, as well as NPCs images in game.

3.1.1.4 Twitter

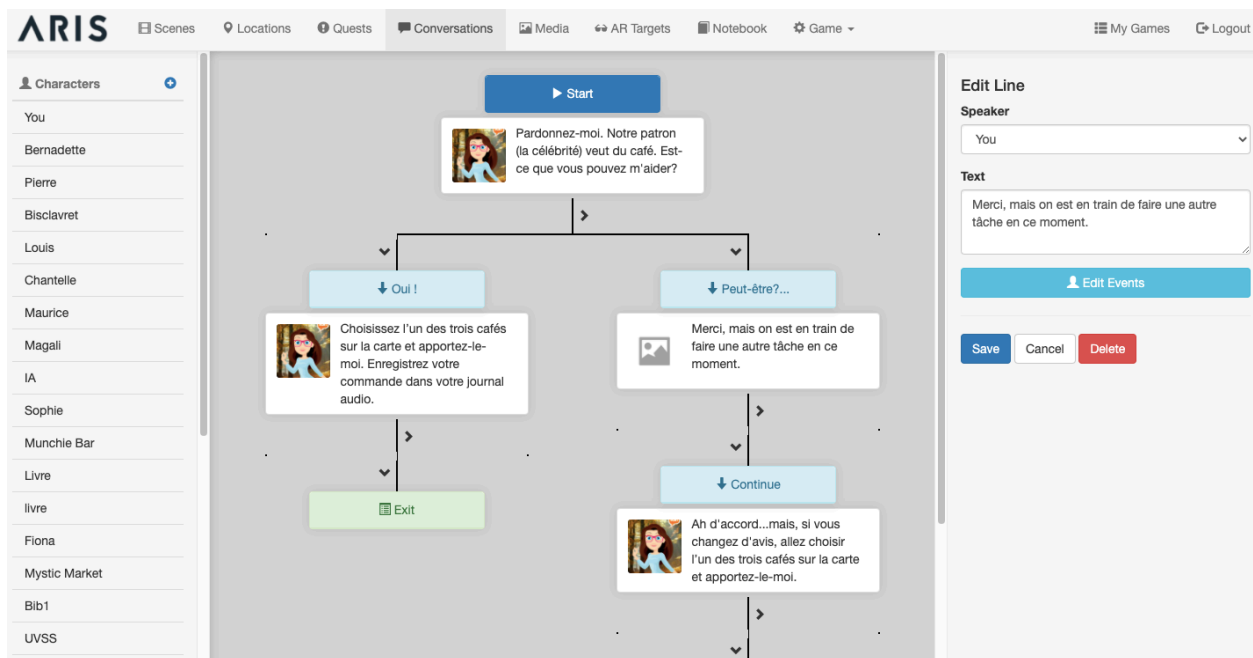
The social networking microblogging service Twitter was used during gameplay for audio/video journal entries. Additionally, students used Twitter to document their gameplay or respond to specific tasks, such as answering questions. Twitter integration for gameplay was first employed for the ARIS game *UNCT (UVic Normal Campus Tour)*, with the goal of adding collaborative elements for ARIS gameplay (see Perry et al., 2015 for more details), and iteratively adjusted for the present research (see section 3.1.4.2 *Challenges with Twitter* for more details).

3.1.2 *Explorez 2.0* quests and game elements

The fundamentals of *Explorez 2.0* quests consist of several components, such as requirements for quest completion and obtaining the badge, as well as NPC characters and dialogues (see Appendix D for a detailed description of *Explorez 2.0* quests). However, each quest also includes several other elements (11 to 36 per quest) such as objects, hints, additional character conversations, as well as links to media. Examples of objects include plaques, items, and conversations. *Plaques* are a static game object with a text field and the option to upload media (sound, video, image). *Items*

share the same fields but with the additional functionality of being picked up and dropped by players. *Conversations* (see Figure 3) are primarily used to create branching dialogue between players and NPCs. The ARIS 2.0 branching dialogue is an immense improvement for development, not only creating a more game-like experience for players, but also facilitating ease of allowing more options for players during development. As seen in Figure 4 characters are created in left side bar. The right side bar in the drop down menu allows you to choose the character and write the text/dialogue.

Figure 3. Conversations tab



Note. Left sidebar – create and access characters, center screen – create branching conversations, right sidebar – edit text and choose speaker.

The first iteration of *Explorez* for the present research (as well as the 2015 final iteration), employed badges as the primary game object used to trigger next quests. However, with the addition of two new quests at level 2 (Le SUB and Mystic Market), the goal of providing learner

option to choose their own learning path and the new means of organization via scenes in ARIS 2.0, the iterative development of *Explorez 2.0* ultimately employed *conversations* (be it exiting or employing a specific conversation line) as the system trigger to access quests 6-9 and 11-12. With the addition of *scenes*, and the change scenes locks function, ARIS 2.0 was also no longer linear as in the prior version, and facilitated creating player choice while progressing through gameplay, as seen in Figure 4 which shows potential player quest schema. The iterative development of *Explorez 2.0* entailed playtesting each new design element to evaluate if it was an effective and efficient option, and then I iterated back to design/development stage in the Design Science framework as necessary.

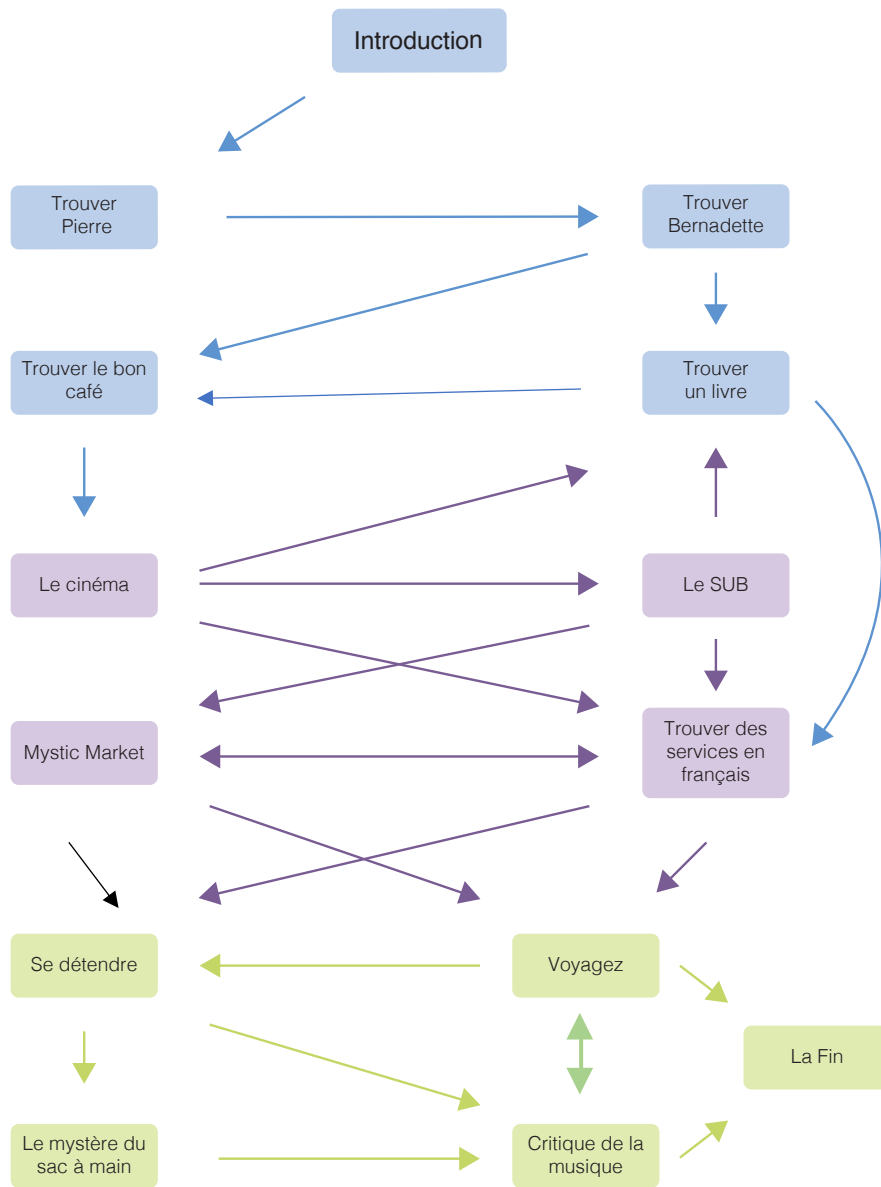


Figure 4. Possible player quest progression

More details regarding the development and challenges of the tools is covered in section 3.1.4.

3.1.3 Description of the tool VdeUVic

Visite normale de Uvic (VdeUVic) is a French version of *UVic Normal Campus Tour (UNCT)*. *UNCT* was developed and tested as a group project for a CSCW (Computer Supported Collaborative Work) course (Perry et al., 2015), and focused on extending collaborative potential in ARIS games. *UNCT* includes dispersed collaborative game elements among separate teams during gameplay, as well as co-located teamwork. However, given that dispersed collaboration was novel within the context of ARIS games, during the design stage the research team had no prior examples of how the proposed objectives of dispersed collaboration might be accomplished. After research into potential options, the team chose to adapt Twitter, as well as create a game to incorporate the Twitter functions, in order to explore their potential affordances and limitations for collaborative gameplay. *UNCT* was therefore developed with the intention of generating situations which would entice teams at different locations to share information, via Twitter, to help each other solve a puzzle. *UNCT* is a virtual narrative treasure hunt, designed to be playable in one session, taking less than an hour for gameplay.

UVic Normal Campus Tour begins as the title suggests, a normal campus tour. One of the three virtual guides, Sophie, welcomes players to the University, and explains that each guide will take a group of students around to a different area of the campus. Sophie then states that an international student has missed her flight and is unable to join the tour. Players are asked to tweet about the tour using the gameplay hashtag (#VdeUVic for the French version) so the student will be able to follow the tour on Twitter.

The premise of *UNCT/VdeUVic* is that three groups of students begin a routine tour of the campus that ends up taking an unexpected turn. The players follow their guide to escape the danger

nipping at their heels and collect magical items along the way. The narrative element asking players to tweet, in order for an international student to follow the tour via Twitter, was added in order to explain the use of Twitter without giving away the twist in the story before the werewolf and the cloaked stranger intent on killing the beast appear mid-game.

When the three teams meet for the end scene, located in the Quad of the University, each arrives with two unique items collected during the tour. The three groups must collectively choose between two outcomes by combining a set of items. While ARIS does not support direct trading of items, an in-game mechanic to emulate trading was employed: dropping items within the game allows other players to pick them up. This exploit allows teams to work together and collaborate to choose the ending. The final gameplay events are only triggered once one of the players has all three of the necessary items in his or her inventory.

The purpose of *UNCT* is not simply to function as a tour for the University, but also to serve as a team-building exercise, and therefore other objectives include collaboration and team cohesion. Game design paralleled the parameters from Nasir et al.'s (2015) study, incorporating the nine parameters of multi-player video games from prior research: *complexity, user interface, difficulty, subject matter, participation, unique roles, social interaction, collaborative patterns, and synchronicity* (see section 3.4 *Gaming Research* for more details). All of these parameters were considered and implemented in *UVic Normal Campus Tour*. However, since collaboration is the focus of the present study, the most pertinent parameters are participation, social interaction, and collaborative patterns.

For the present study, I translated all the content in *UNCT* into the French version *VdeUVic*. Feedback from student testing during Perry et al.'s (2015) study was also incorporated in the next

iterations of *VdeUVic*. Copies of the game were created for each cohort. Given that the game was originally created in English, and the fantasy narrative included many vocabulary words new to all levels of current players, gameplay for Fran 120 and 100 level versions included a vocabulary list for student reference, as well the in-game translation of certain words so that players could follow the story without needing to constantly look up vocabulary. This included simplifying the narrative during the end scene.

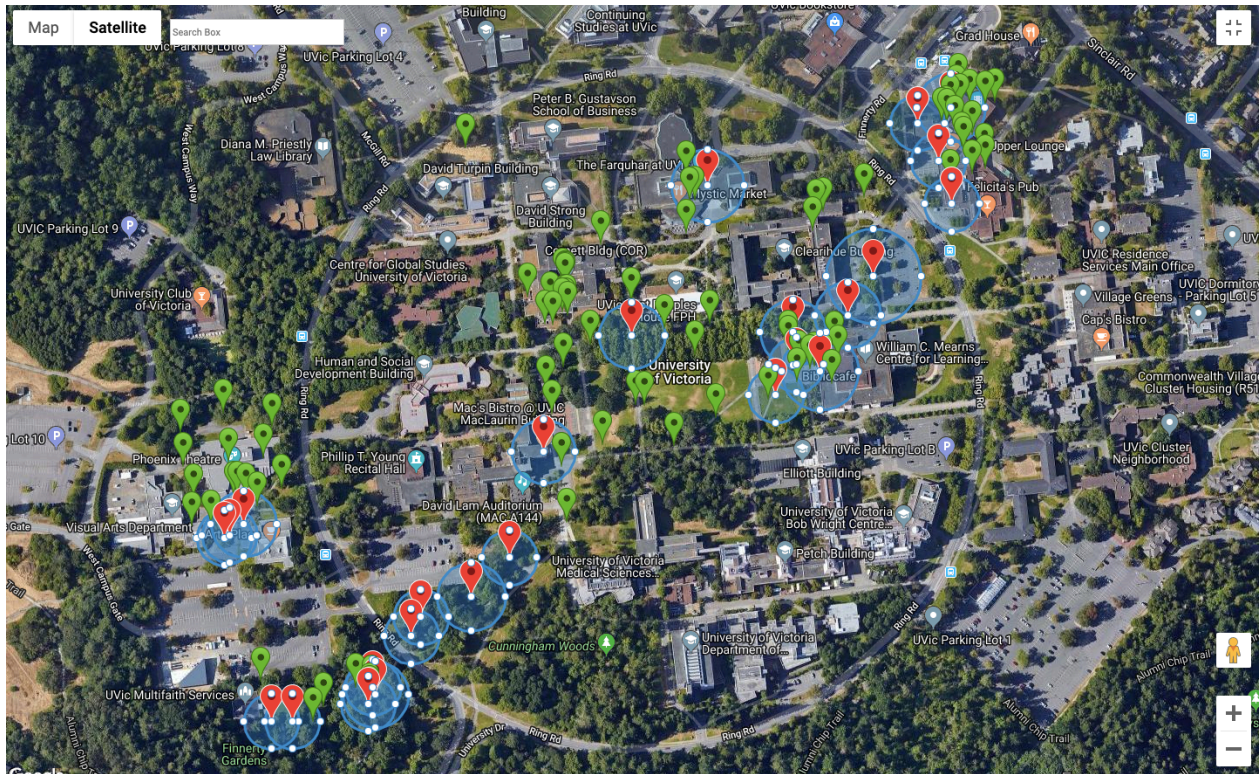
3.1.4 Development additions, modifications, and challenges

Explorez 2.0 became much more complex during the redesign and development stages when incorporating student feedback from previous testing, as well as the additional elements available in ARIS 2.0 (i.e., branching conversations, and the AR camera overlay feature). In fact, *Explorez 2.0* ultimately expanded to consist of over 250+ game elements, an increase from 80+ from the 2015 version (for example: hints, character conversations, media, and pop-up questions and tasks strategically placed when gameplay required students to walk between gaming locations). As mentioned previously, the iterative development of *Explorez 2.0* required that I test all gaming elements to evaluate their effectiveness and iterate back to design/development stage in the Design Science framework as needed.

As seen in Figure 5, a screenshot of the ARIS UI map view shows the locations of game elements on the UVic campus. One of the learning goals is also to provide a contextual and immersive learning experience (Thorne & Hellermann, 2017). As Lantolf and Thorne (2000) state: [b]ecause SCT [sociocultural theory] construes language as a cultural tool used to carry out concrete goal directed activities... evidence must be sought in tasks in which language is a means

to some concrete end. These can be tasks that parallel activities in the everyday world (208). The quests in *Explorez 2.0* meet this criteria with tasks such as ordering a coffee in French at the University coffee shop, finding a specific book at the library, discovering resources, such as the French help center, and then using these real-life environments to learn and employ relevant vocabulary.

Figure 5. Screenshot of Explorez 2.0 UI map view.

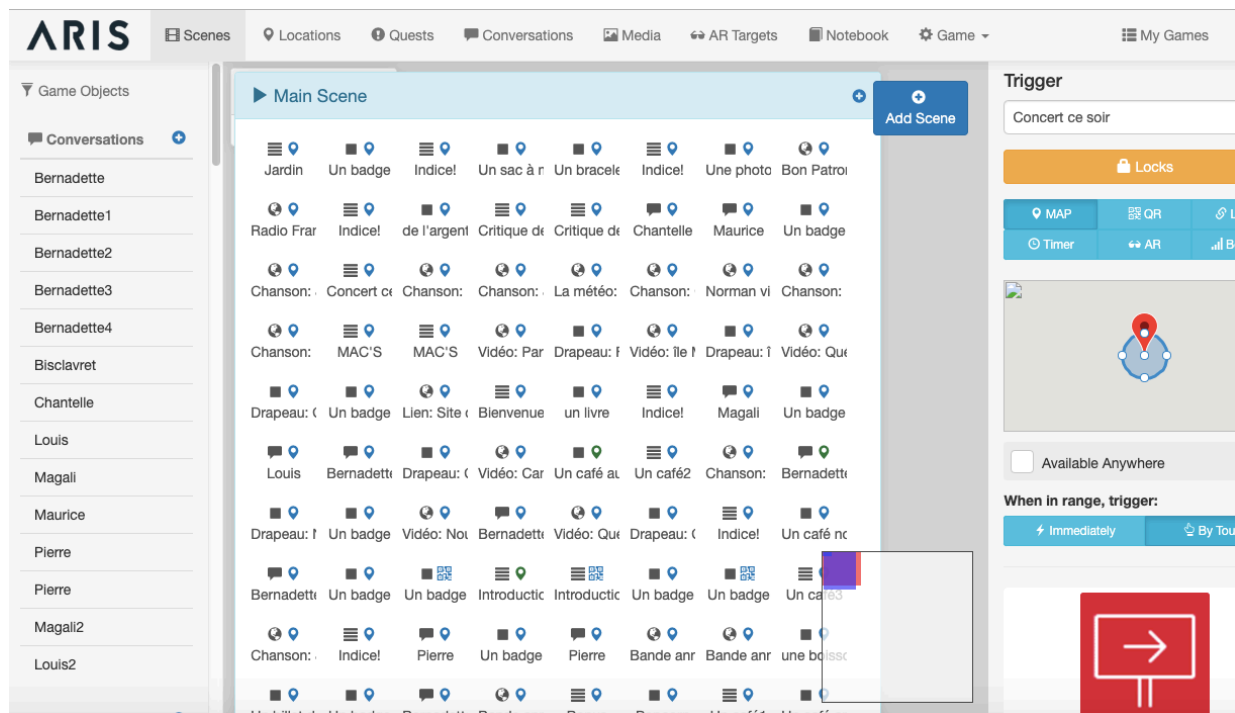


Note. Red icons are place based triggers, and green icons are available anywhere game content thus using one of the other game locks for players to access content.

3.1.4.1 ARIS 2.0 scenes

ARIS 2.0 substantially impacted the redesign of *Explorez 2.0*. Unfortunately, when *Explorez* was migrated into ARIS 2.0, many locks and triggers were not functioning, and the organizational means had completely changed with the inclusion of scenes. Figure 6 is a screenshot of the original *Explorez* when it was ported into the upgraded platform.

Figure 6. Scenes UI of *Explorez* imported into ARIS 2.0



In the previous version the UI left panel allowed the developer to create folders and sub-folders to organize game content. The quests in *Explorez* were organized in such a manner with all the elements for each quest in the relevant folder. However, in ARIS 2.0 the left panel organizes objects by type (conversations, plaques, player attributes/items, web pages, events). At first, I

attempted to debug the imported version of *Explorez*, but after numerous hours of troubleshooting it became apparent the best option was to begin again.

Thus, I recreated all the objects, quest by quest, but developed quests within their own scenes (see Figure 7). This facilitated not only the organizational aspects of gameplay during development, but also for future use, as one of the goals had always been to be able share *Explorez* should another language instructor want to modify it for gameplay on their campus. As seen in Figure 7, nine of *Explorez 2.0*'s 12 scenes are visible, each containing the game objects for said quest. The green arrows between scenes are the multiple triggers to change scenes granting the player access to a different quest. Thus, employing scenes in such a manner also facilitated the goal of students being able to pursue their own learning path in the system.

Additionally, I created a scene containing a hack to access each individual quest, containing the relevant badge (or other needed trigger) in order to assist the process of troubleshooting issues. Each quest and level of *Explorez* builds on previous ones, therefore without this hack it would not have possible to troubleshoot a quest at level 3 without first playing through the previous levels.

3.1.4.2 Challenges with Twitter

Twitter integration for gameplay in ARIS was first employed in *UNCT (UVic Normal Campus Tour)* and included two Twitter functions: one to post gameplay tweets, and the second to read the other teams' tweets during gameplay. These two functions were integrated directly into the design platform of ARIS (see Perry et al., 2015 for more details). Unfortunately, the *UNCT* integrations no longer functioned after the next Twitter update, and troubleshooting the issues proved more difficult than worthwhile. Therefore, when developing the next iteration of *Explorez*, I simplified

the process by placing the Twitter website link into a game object which students could access in their inventory or directly in the game menu. This option appeared to function well during development playtesting. However, during playtesting with the first cohort (Fran 160) this method also proved to be unstable, appearing to be due to the fact that numerous students were playing *Explorez* at the same time. Ultimately, to avoid unnecessary technical issues, players were instructed to double click the home button to access Twitter in another window when needed during gameplay.

3.1.4.3 ARIS AR camera overlay feature

The ARIS AR trigger option (AR camera overlay feature) is supported by Vuforia. ARIS holds a license with Vuforia, and authors open a free account on Vuforia.com to use the service. Vuforia creates the AR markers from uploaded 2D images, which the developer then imports into ARIS. An issue in the first iterations of *Explorez* (Perry, 2015) was that indoor locations employing GPS location as the trigger were at times unstable. Employing QR codes was an option to solve the issue, but the developer encountered challenges when seeking permission to place the QR codes at the necessary locations on the University campus for the present research. The addition of the ARIS AR camera overlay feature solved this challenge, and all indoor game locations in the next iterations of *Explorez 2.0* were made stable by employing AR triggers when gameplay takes place inside a building and a specific location is required as a trigger.

3.1.4.4 Voki

Voki was also used for the images of NPCs within *Explorez*. Screenshots of Voki-created avatars were employed in Perry's 2015 version; unfortunately, the links to speaking avatars did not function when inserted into the ARIS platform. An objective for the present research, and next iterations of *Explorez*, was therefore to also include talking avatars in levels 2 and 3 for increased audio comprehension during gameplay. This was accomplished by creating the speaking avatars in Voki and then employing QuickTime screen capture to record the videos. The video files were then uploaded into ARIS. To facilitate gameplay, and different levels of learners, each speaking avatar also includes the option for players to access the content in written text for clarification if needed. This is accomplished through branching conversation giving the player the option to either continue to the next step, when they understand what the avatar has said or they can choose the option stating they did not understand and need the information repeated.

3.1.4.5 Additional gaming elements

Additional gaming elements were added based on player feedback from previous testing, as well as observations and findings to improve the tool and player experience. In order to address potential lapses of silence when players are navigating from one location to the next, I incorporated strategically placed hidden elements on the map (triggered by location) or timed elements (triggered by amount of time since last encountered game element). The content of these elements may include a link to online media or an NPC suggesting tasks or asking questions. During the introduction scene two bonus options are also offered to players. While players are walking to locate Pierre and Bernadette (for Quests 1 and 2) IA NPC pops up to let the players know that the

celebrity is interested in sustainability and would like to know in what ways UVic is a green campus. Players are encouraged to tweet and informed that, each time they tweet, they can earn bonus experience points (XP). A second bonus option is offered near the end of the starting scene stating the celebrity is also interested to learn about culture at UVic. Throughout gameplay, IA appears at opportune times to remind players of the two tasks. Additionally, IA pops up during each quest and asks multiple choice questions regarding vocabulary specific to the player's course content for additional bonus points.

Another addition to *Explorez 2.0* is the use of JavaScript within the ARIS platform (ARISjs) to include sound effects and device vibrations during gameplay. ARISjs not only improves player experience, it is also essential regarding hidden map items. Sound effects and/or vibrations notify the players when they have accessed game content while walking between locations and may not be looking at the device.

After each testing session I incorporated student feedback and data from viewing gameplay videos, in order to improve both language and gameplay scaffolding. For example, after the first testing session with cohort 1 Fran 160, I created a 30-second tutorial regarding badge pick-up that pops up after completing the first quest. This was incorporated when, despite AI's dialogue stating the need to pick up badges, some students pressed forward intent on going to the next location without picking up the badge. Since the gameplay content was not yet available, as the system required the badge to trigger the next items, this ultimately caused player confusion. Additionally, for testing groups 2 and 3, I also created two tutorial videos, one on ARIS gameplay and the other on how to use Twitter. These tutorials are integrated directly into the gamified system and are triggered automatically at the appropriate time to facilitate both ARIS interface and Twitter use

for players (especially pertinent given that these two groups were not already employing Twitter for class activities).

Copied versions of both *Explorez* and *VdeUvic* were made for each language cohort. In *Explorez*, the bonus questions were then adapted for specific vocabulary for each class content and the players level of French. For cohorts 2 and 3 (Fran 120 and Fran 100 lower levels) the *Introduction* was adapted to include certain instructions repeated in English to make certain players understood key gameplay elements. Additionally, vocabulary not necessarily known to the learner level, (such as the bonus tweeting for sustainability, which was a topic specifically covered in Fran 160), AI “spoke” to players in Franglais (code switching) introducing new French vocabulary and reiterating key words and phrases in English.

As mentioned previously the development of these types of gamified systems is an iterative process, which also require many adjustments in the final stages, especially when elements are location-based, as is the case of both *VdeUvic* and *Explorez 2.0*. In fact, for location-based triggers the only way to verify changes is to physically go to the locations and test all the elements. Therefore, I playtested both systems and then piloted them with participants (5 graduate students who would also assist the French students during the play sessions) to attempt to identify any design issues before conducting the study with the students. The resulting feedback was incorporated before the first official testing session.

The entirety of section 3.1.4 *Development additions, modifications and challenges* highlights the need for iterative development and playtesting. Additionally, I also employed this DBR iterative process between student playtesting sessions in order to facilitate both gameplay and language scaffolding as much as possible.

3.2 User study/Participants

The target population for the present study are university French language students, at various levels of competencies from complete beginner to beginner/intermediate levels. More specifically, the system was specifically designed for Fran 160⁴ students; however, as Perry's (2015) study showed the slightly lower-level Fran 120 students also benefited and were capable of the tasks and gameplay. For each cohort, I first approached the instructors and, after gaining permission, visited the students during class time to explain the research and the gamified tools. All students would participate in gameplay as a class activity, but I requested volunteers to participate in the study, following the research ethics protocol⁵. Consent forms were handed out and those choosing to participate signed the necessary documentation.

The addition of the third cohort, Fran 100, occurred because the language lab instructor that was assisting with playtesting for the other groups approached me requesting that her students be included and offered the opportunity to play *Explorez 2.0*. I therefore also approached the Fran 100 instructor for permission, and then visited this class to explain the study and tools, as well as request participants for the study, and seek signatures for the necessary documentation of those willing to participate. Time constraints, and logistics resulted in the whole class playing *VdeUVic* during class time, and then only 9 out of 29 students (representing the one language lab cohort) also playing *Explorez 2.0*. Although gameplay had never before been attempted for this level of learner,

⁴ Fran 160 is a course for beginner/intermediate students (A2/B1 levels of the CEFRL [Common European Framework of Reference for Languages]) to develop their vocabulary.

⁵ University of Victoria Human Research Ethics Protocol Number 18-263

it was deemed an interesting endeavor to see how beginner level French students would interact with the tools and each other.

Therefore, participation in the study was voluntary with three cohorts of different levels of French students playtesting both *VdeUvic* and *Explorez*. In total 97 students played *VdeUvic*, and 77 of these students also played *Explorez*. Fifty-eight of the 77 students that playtested both gamified systems chose to participate in the study. Table 2 below provides additional details regarding the term in which the students participated, the total number of students that played both gamified systems, and the number of students that participated in the study.

Table 2. Participants per course level

Term	Fall 2018	Spring 2019	Spring 2019
Level	Fran 160	Fran 120	Fran 100
# of students that participated in gameplay	41	28	9
# of students that participated in study	33	17	8

The logistics for arranging testing groups differed slightly for each cohort. Testing groups for Fran 160 were organized to include a student willing to use their iPhone and a small amount of data for playtesting. The remaining team members were added randomly. This cohort was already using Twitter for class activities; therefore, team members already had some experience with the use of Twitter encouraged during gameplay. However, Fran 120 and Fran 100 cohorts were not using Twitter in class. Additionally, since available playtimes for these cohorts would be 10-20 minutes shorter than Fran 160 sessions, steps were taken to facilitate the necessary set up time before gameplay could begin. Therefore, iPhones with access to data for gameplay were supplied for both Fran 120 and Fran 100 participants, eliminating the ARIS download, account creation and login process, as well as the need for participants willing to use their iPhone and data.

The Fran 120 cohort was also given the opportunity to create their own teams and asked to email me if they wished to do so. Only one group of four students was self-selected, and I arranged the remaining teams. Drawing from information from the pre-questionnaire, each team included a member that had experience with an iPhone, as well as a student that had Twitter and/or gaming experience (on some occasions this was the same student). Otherwise, additional team members were added randomly to create the groups. Fran 100 participants were arranged in the same manner as the Fran 120 cohort with no teams self-selecting. The link to the pre-questionnaire was emailed to the participants. Testing groups were as follows as seen in Tables 3, 4 , and 5:

Table 3. Fran 160 testing groups

Teams	# of students			Notes
	Session 1	Session 2	Session 3	
Bleu A	3	3	4	same students S1 & S2, student
Bleu B	3	3	dissolved	2 absent students during S3, remaining one joined Vert C team
Bleu C	3	3	3	same students all 3 sessions
Rouge A	2	4	3	2 students joined during S2, 1 student absent S3
Rouge B	2	2	2	1 student same all 3 sessions, but a different partner each session
Rouge C	2	3	3	1 student joined during S2, same 3 students for S3
Vert A	3	3	3	same students all 3 sessions
Vert B	3	dissolved	dissolved	1 absent student remaining 2 joined Rouge A
Vert C	3	3	4	same students except added 1 member S3
Jaune A	3	3	3	same students all 3 sessions
Jaune B	3	3	dissolved	2 absent students S3, remaining 1 joined RB
Jaune C	3	dissolved	dissolved	2 students S2 & S3 another student placed in another team
Total # teams	12	10	8	

Table 4. Fran 120 testing groups

Teams	# of students			Notes
	Session 1	Session 2	Session 3	
Vert A	4	4	4	Same students all 3 sessions
Vert B	3	3	3	Same students all 3 sessions
Vert C	3	3	3	Same students all 3 sessions
Bleu A	3	3	3	Same students all 3 sessions
Bleu B	3	3	dissolved	2 students absent, remaining student chose not to do S3
Total # teams	5	5	4	

Table 5. Fran 100 testing groups

Teams	# of students			Notes
	Session 1	Session 2	Session 3	
Vert A	2	2	2	Same students all 3 sessions
Vert B	3	3	3	One original team member absent S3, another student joined this team
Bleu A	2	3	2	Same student absent S1 & S3
Total # teams	3	3	3	

As seen in the notes section of the tables 3, 4, and 5, not all teams contained the same participants for all three sessions. The team logistics were fluid, depending on student attendance. There were several student absentees amongst the teams during playtesting, ultimately affecting all three cohorts. I made last minute adjustments to teams as needed, in order that each team had access to an iPhone, and every student had at least one other team member for gameplay.

3.2.1 Participant profiles

Before the playtesting sessions participants were asked to fill out a pre-questionnaire. This information was gathered to create participant profiles regarding “the levels of technology fluency and patterns of use... [including] comfort and fluency in unique areas including software, mobile communications, gaming, social networking, and prevalent school technology experience”

(Haskell & Pollard, 2008). The participant profiles include information regarding demographics, as well as their previous experience with and attitudes towards social/digital media and games. Additional information regarding the amount of time participants spent on technology mediated activities and games (both overall and on a mobile device) was also collected (see Appendix X).

The age of participants ranged from 17 to 50. From data set 1 (Fran 160) of the 26 participants that filled out the pre-questionnaire 21 were 17-21 years old, two were between 22 and 25, two were between 26 and 30, and one was between 36 and 40. From data set 2 (Fran 120) nine of the 14 participants were aged 17-21, four were between 22-25, and one was between 41-50. In data set 3 (Fran 100) four of the six participants were between 17 and 21 years old, and the other two were 22-25 years old. Regarding the native language of participants, 22 participants from Fran 160 stated English was their first language, one answered French, and the remaining 3 stated other (1 Portuguese, 2 Japanese). From the Fran 120 cohort, ten answered English as their first language, one responded French, and three stated Mandarin as their mother tongue. Three of six participants from Fran 100 answered English as their first language, and the remaining three stated other (2 Mandarin, 1 Vietnamese). Regarding participants' background in French, the majority of participants responded French as a second language. In the Fran 160 cohort 20 of 26 stated FL2, another five said French immersion, and one answered they had francophone parents. Of the 14 Fran 120 participants, 13 responded FL2, and one answered French as a third language. Five of six participants from Fran 100 answered FL2, and the remaining one stated French as a fourth language.

3.2.1.1 Experience with digital media

In regards to participants experience with digital media, the participants were asked to self-evaluate their level of experience with the following technologies on a Likert scale of 1 to 6 (1= not experienced at all 6= very experienced): social networking (such as Facebook, Twitter, Snapchat, Instagram), educational apps (such as WordRef, Duolingo, Dictionaries, Bon Patron, etc), reading news, articles or books online, cloud computing (Dropbox, Google Drive, etc.), and audio or video sites or apps (Youtube, Spotify, Itunes, etc). Fran 160 students were the most experienced with audio or video sites or apps, while Fran 120 participants stated they were the most experienced with social networking. Fran 100 students were most experienced with reading news, articles or books online as well as using audio or video sites or apps. All three cohorts answered that they were the least experienced with educational. These questionnaire results can be observed in Table 6.

Table 6. Experience with digital media

Digital Media	Mean average on 6 point Likert scale		
	Fran 160	Fran 120	Fran 100
Social networking (such as Facebook, Twitter, Snapchat, Instagram)	5.08	5.21	5
Educational apps (such as WordRef, Duolingo, Dictionaries, Bon Patron, Linguee)	3.88	3.93	4
Reading news, articles or books online	4.5	4.71	5.33
Cloud computing (Dropbox, Google Drive, etc.)	4.42	4.21	5
Audio or video sites or apps (YouTube, Spotify, iTunes, etc.)	5.35	5	5.33

Participants' use of social media sites was also of interest to the present research. The participants were asked to indicate the frequency with which they use the following social networking sites on a Likert scale of 1 to 6 (1= not at all 6= very often): Twitter, Facebook, Instagram, Snapchat,

Messaging apps (Telegram, WhatsApp, etc.), Skype or Facetime. The most used social media site across all three cohorts was Instagram, and the least used social media site for three data sets was Twitter. The mean results of the social media sites for each cohort can be observed in Table 7.

Table 7. Frequency of social media use

Social Media	Mean average on 6-point Likert scale		
	Fran 160	Fran 120	Fran 100
Twitter	2.38	1.79	2.33
Facebook	3.85	3.57	3.5
Instagram	4.58	4.79	3.83
Snapchat	3.81	3.57	2.67
Messaging apps	3.19	4.43	2.83
Skype or Facetime	3.38	2.36	2.67

In regards to participants' attitude towards using technology for learning, most students reported on the positive end of the spectrum. Students were asked to rate their attitude towards using technology (such as social media, cloud computing, mobile applications, etc.) in courses or for studying on a Likert scale of 1 to 6 (1=strongly negative 6=strongly positive). Fran 160 reported with a mean of 4.31, Fran 120 with a mean of 4.21, and Fran 100 reported with a mean of 4.5. The percentage and number of students for each answer as well as the mean can be observed in Table 8.

Table 8. Participants attitude towards using technology for learning

	Fran 160	Fran 120	Fran 100
1 (Strongly negative)	1	0	0
2	0	3	0
3	3	0	2
4	11	5	1
5	8	3	1
6 (Strongly positive)	3	3	2
Mean	4.31	4.21	4.5

3.2.1.2 Gaming experience, motivation, and use

Participants were also asked to self-evaluate their level of experience on a Likert scale from 1-6 (1 = none-never played 6 = very experienced) of the following games: board games, single player computer/console games, multi-player computer/console games (online or in person), massively multiplayer online gaming (such as World of Warcraft, Runescape, etc.) and mobile games (such as PokemonGo, Clash of Titans, Candy Crush, etc.). Both Fran 160 and Fran 120 cohorts reported being the most experienced with board games, while Fran 100 stated the most experience with single player computer/console games. All three data sets reported the least experience with MMOs. Table 9 provides the mean average of each game type and data set.

Table 9. Participant gaming experience

Game type	Mean average on 6-point Likert scale		
	Fran 160	Fran 120	Fran 100
Board games	4.38	4.21	4.17
Single player computer/console games	3.54	3.71	4.5
Multiplayer computer/console games (online or in person)	2.88	3.57	3.83
Massively multiplayer online gaming (such as World of Warcraft, Runescape, etc.)	1.88	2.93	2.83
Mobile games (such as PokemonGo, Clash of Titans, Candy Crush, etc.)	3.19	3.64	4

In response to the question “What motivates you when playing a video game?” the top selection for Fran 160 participants was “competing to beat the game or my personal best” with 14 of 26 (53.85%) choosing this response, followed by “socializing with friends and other people,” and “escaping from real-life concerns temporarily” each with 13 of 26 (50 %) participants reporting. The top reported responses for Fran 120 participants were “socializing with friends and other people” and “completing missions and achievements” with 8 of 14 participants (57.14 %) choosing

these responses. Next 50% (7 of 14) of Fran 120 students stated they were motivated by “competing to win against other people” and “competing to beat the game or my personal best”. The top selection for the Fran 100 cohort regarding motivation when playing a video game was “escaping from real-life concerns temporarily” with 5 out of 6 (83.33%), followed by “socializing with friends and other people” with 4 out of 6 (66.67%). The results to this question are displayed in Table 10, displaying the number of students that chose each answer from each cohort.

Table 10. Motivation when playing a video game

Motivation during gameplay	Fran 160	Fran 120	Fran 100
	# of participants that chose the answer		
Socializing with friends & other people	13	8	4
Competing to win against other people	5	7	2
Competing to beat the game or my personal best	14	7	1
Learning the rules &/or levels of a new game	3	3	3
Completing missions and achievements	3	8	3
Educational component (ex. language, history)	6	1	3
Collaborating with other players (against a common enemy, solve puzzles together, work together towards an objective)	2	3	3
Escaping from real-life concerns temporarily	13	6	5
N/A - I don't play video games	2	1	0

3.2.1.3 Mobile gameplay

Pertaining to the use of a mobile device (or several devices), the vast majority of participants reported using one on a regular basis. Twenty-five of 26 Fran 160 participants (96%) answered that they use a mobile device regularly, and 100% of both Fran 120 and Fran 100 participants reported that they use one on a regular basis. In regards to mobile games, 18 of 26 participants from Fran 160 stated that they play mobile games on their smartphone, with 10 of these students

playing 5 min or less on average a day, four students playing 6-15 minutes a day, two students 16-30 minutes, and two playing ½ hour-an hour a day. In the Fran 120 cohort, 10 of 14 participants responded they play mobile games on a smartphone. Five participants reported playing five minutes or less on average a day, three students 6-15 minutes a day, one 16-30 minutes, and one participant playing more than two hours a day. Three out of 6 participants from Fran 100 data set report playing games on their phone with one playing 16-30 minutes a day on average, one ½ hour-an hour a day and one playing more than two hours a day.

3.3 Data collection

The evaluation of the AR language tools for learner collaboration is implemented by means of a micro-analysis in order to collect data of both a qualitative and quantitative nature, through pre and post-play questionnaires, interviews and the gaming platform itself (quests completed, badges collected). Additionally, student gameplay interactions were video recorded for future analysis. The case study employed a hybrid method of analysis, but by no means sought to compare two different learning contexts.

The pre-questionnaire (see Appendix A) was adapted from Perry's (2015) study which analysed the L2 gamified system *Explorez*. Additionally, after researching studies on collaborative learning, questions were adapted from Brown's (2008) study to garner the students' perspectives on CL. Questions for the post-questionnaire (see Appendix B) were also adapted from Perry's (2015) study and further questions added after examining similar studies pertaining to AR implementation regarding user experiences (Haller, Billingham & Thomas, 2006; Michelsen & Bjork, 2014). The same questions inspired from Brown's study were also included in the post-

questionnaire to glean students' perspectives on CL specifically in relation to the gamified tools and their learning experience. The questionnaires were piloted to a convenience sample of undergrad and graduate students before testing to verify that the type of data gathered would address the research objectives.

For data set 1 session 1, the aim was to record gameplay of six of the nine teams using three different types of recording devices. Two teams used GoPros with head mounts, and the individual wearing the GoPro was also asked to hold the phone to capture interactions with the device. Another two teams were accompanied by either myself or a teaching assistant (TA) and were recorded with camcorders. The last two teams were supplied with camcorders with one team member recording and another member holding the mobile device for gameplay (however unfortunately during this first session one team forgot to take their camera when they commenced gameplay). I reviewed the videos after session 1, and it was evident that the GoPro recordings were the best option. Three additional GoPros were purchased to use for the remaining sessions.

Table 11 provides additional details regarding each data set, when it took place, the French course level, the length of each session, the total number of students that played both gamified systems, the number of students that participated in the study, the number of students that filled out both questionnaires, the number of students that participated in an interview or focus group, and the hours of video recordings for analysis.

Table 11. Detailed summary of data set information

Data Set	1	2	3
Term	Fall 2018	Spring 2019	Spring 2019
Level	Fran 160	Fran 120	Fran 100
# of sessions	3	3	3
Length of each session	~ 80 mins	50-60 mins	~ 50 mins
# of students that participated in gameplay	41	28	9
# of students that participated in study	33	17	8
# of students that filled out both questionnaires	22	11	6
# of students that participated in interview/ focus group	13	6	3
# of hours of gameplay video recordings	20	14	7.5

After completing the three gameplay sessions participants were emailed the post-play questionnaire. The final question on this questionnaire asked participants if I could email regarding a focus group to ask additional questions for more in-depth answers regarding their experience with the tools (see Appendix B). Those that replied “yes” were emailed to arrange for a meeting time at their convenience. Time constraints on the part of the participants resulted in only one focus group of four students for the Fran 160 cohort. The remaining 18 participants from all three cohorts were interviewed individually at a time of their choosing. In total, of the 58 participants that participated in the study 39 students filled out both questionnaires, and 22 of these students also participated in an interview/focus group.

3.4 Procedure

This research took place on the University of Victoria campus. Each gameplay session began in the corresponding students’ classroom and then players were directed by the gamified system to different campus locations for gameplay. Testing took place from October 2018 to April 2019 with

58 student participants participating in the study. In total there were nine testing sessions varying from 50-80 minutes each (three sessions per cohort).

Each participating cohort was visited during class time (after first approaching the instructors, and gaining permission) to explain the research, and the gamified tools. The three sessions of gameplay per cohort were conducted as class activities, but I requested participants to participate in the study, following the research ethics protocol. Consent forms were handed out, and those choosing to participate signed the necessary documentation. The pre-questionnaire was emailed to students that agreed to be part of the research.

3.4.1 Data set 1 - Fran160 Fall 2018

In addition to the initial class visit, I visited the Fran 160 class a second time to demonstrate the user interface of ARIS and the gamified systems, as well as request participants to use their iPhones for gameplay. Students were sent documentation detailing dates, times, and team members in preparation for sessions via the UVic learning management system Coursespaces, as well as the instructions for downloading the ARIS app, and creating an account.

3.4.1.1 Fran 160 Session 1

As students arrived to class, I indicated that there was a master list at the front of class detailing all teams and their team members. Students were asked to check which team they would be joining and note the colour and corresponding letter of their team (red, blue or yellow; A, B or C), if they didn't recall this information from the online message sent previously. They were also instructed to take a sticker from beside the list with the corresponding colour of their team and place it on a

visible area of their outer clothing, which would assist in identifying their teammates (and later on the TA assigned to their section of the game, as well as the other two teams they would join for the end scene of the game). Students were asked to find their teammates and sit in adjoining desks. As the teams began to form, and the remaining students filed into class, I asked the participants who had volunteered to use their iPhones for gameplay to login into the ARIS application, and I once again gave instructions on how to find and load the game *VdeUVic*. The two assisting TAs had also been shown how to login, so we assisted those students who had difficulty (a couple students had not yet downloaded the app, several students didn't recall their login information, and a few devices crashed when loading the game).

I then described the activity and advised the students that if they encountered issues to speak with the TA wearing the same-coloured sticker as they were wearing. Additionally, as the goal of the activity was to explore the campus in the target language, if they had issues with the system students were encouraged to tweet in French about the campus and meet the group at the quad at the designated time. I then named off the teams that would be recorded and asked these team members to stay an additional few minutes. The remaining teams were informed they could commence gameplay. The recording devices were handed out to the teams self-recording, and they were instructed how to use the device. The remaining five teams commenced gameplay, with two of these teams being recorded by myself and a TA.

3.4.1.2 Fran 160 Session 2

As students arrived, they were asked to find and join their teammates. Participants using their iPhone for gameplay were asked to login to ARIS and the game *Explorez*. I explained the activity

and also the options for recording audio or video entries on Twitter during gameplay. For this session, the two TAs would remain at hub Quest locations (the library and the SUB) and students were instructed to go to one of these locations if they encountered any issues. Video reviewing from session 1 had shown a team that did not understand the AR tab use; therefore, this was reviewed again and a hack to test the AR tab offered for any students wishing to review its use. Teams were adjusted as necessary depending on students' absentees. I started the five GoPro cameras recording and these were handed out to the teams that would be recording their gameplay. I recorded the same team from the previous session with the camcorder. Students were asked to physically stay in the classroom until they completed the first task involving recording an entry on Twitter in case they required assistance, and instructed to meet at Cineplex at the designated time for the end of the session. Gameplay commenced.

3.4.1.3 Fran 160 Session 3

From reviewing gameplay videos from Session 2 I noted that several teams had at least one instance of the in-game Twitter use crashing while recording or uploading their journal entry. Despite planning to have in game access to Twitter, unfortunately this element was not stable enough. Therefore, to avoid player frustration and/or the need for students to record their journal entries a second time to complete tasks, players were instructed to use the Twitter app. By having the Twitter app also open on their phone in another window, players could double click to navigate between *Explorez* and Twitter when needed. The third session was a continuation of the preceding one. Students joined their teammates, logged into *Explorez* and continued gameplay. Several teams were adjusted due to student absentees. The five teams using GoPros were given the device,

already recording as in the previous session. An additional TA volunteer for this session recorded the sixth team. Players were instructed where to find a TA or myself if issues arose and/or they had questions (same Quest hub locations with the addition of the classroom). Students were instructed to meet outside the library at the designated time.

3.4.2 Data set 2 – Fran 120 Spring 2019

The Fran 120 students had only one pre-play class visit to explain the gamified systems and research. iPhones for playtesting were supplied for this cohort, and I had the devices ready for each session with the ARIS app downloaded, player accounts created and already logged in for gameplay. The necessary preparatory logistics before gameplay could start, that of identifying and finding team members, creating accounts and logging in were facilitated for these students. This was to save time, given the shorter playtime from the previous cohort. Additionally, instead of demonstrating the ARIS interface use in class, the tutorial videos for both the ARIS interface and Twitter use were supplied in-game (see Section 3.1.4.5 *Additional Gaming Elements* for details).

3.4.2.1 Fran 120 Session 1

Once students had arrived, I briefly explained the activity and that team members would be called by name to join their group and accompanying TA/researcher. The class time and groups were divided equally, with four of the teams playing for the first half of class and the remaining teams (4 teams, only 1 team participated in the study) playing for the last half. The TAs were instructed beforehand on how to use the GoPros and asked to assist the students if necessary. The

TA/researcher started the recording and verified that the camera was facing down to capture the iPhone gameplay once the volunteer had the headpiece in place. Each team was guided a short distance outside of the class so as not to disturb the students that would be part of the second round of gameplay. The researcher/TA informed each team that they were there for assistance should the students require it, but otherwise would not interfere. Students began gameplay of *VdeUVic*, and following the introductory game plaque, players were prompted to watch the tutorial on the game interface. Additionally, given that these students were not using Twitter in class, after completing the game introduction (meeting their virtual guide and learning details about the “tour”) the Twitter use tutorial automatically popped up explaining its use for gameplay. At the allotted time these students returned to class, and the remaining students were called my name to join their teams and commence gameplay.

3.4.2.2 Fran 120 Session 2

The procedure for Session 2 remained that same as the previous one. I briefly explained the activity, students were called by name to join their team, the participants willing to wear a GoPro were assisted, and the iPhones were set up to start gameplay. For this session students played *Explorez*, and the tutorial videos were again provided in game. Each team decided for themselves whether or not they needed to view them again. When class was half over the teams returned to class and the remaining students joined the researcher/TA for gameplay.

3.4.2.3 Fran 120 Session 3

Session 3 was a continuation of the previous one. The same procedure was followed, and students continued gameplay of *Explorez*.

3.5 Data analysis

Data analysis included descriptive statistics of the questionnaires, as well as the student interviews and focus group. Video recordings of student gameplay were transcribed and subsequently thematically coded and analysed in correlation to the research questions. This first entailed an analysis of student collaborative episodes pertaining to the target language, technology use, and gameplay. The next level of analysis entailed the adaptation of Volet et al.'s (2009) framework to examine collaborative learning in a gamified learning environment.

3.5.1 Analysis of student interview data and questionnaire responses

In order to examine student perception on their learning experience with the gamified tools (RQ1), as well as ascertain which elements the students identified as useful for language learning (RQ2), descriptive statistics of the post-questionnaire and transcribed interviews were employed (see the map of the research questions in section 3 *Methodology* Table 1).

3.5.2 Analysis of student gameplay video data for collaborative episodes

A goal of the present research was to examine how students collaborate in order to complete the tasks (RQ3). This data analysis entailed descriptive statistics of the video recordings of student gameplay (see the map of the research questions Table 1, section 3 *Methodology*). As mentioned

previously (see section 3.3 *Data Collection*) one team member per group of students wore a GoPro with a head mount during gameplay to capture player and gameplay interactions. This analysis illustrated the ways in which students collaborated to complete the tasks, and also allowed for a comparison of team interactions to examine collaborative patterns.

A first iteration of transcription was done of video sessions, one for each team that had minimal or no changes for team members as well as all three sessions recorded (due to technical issues, human error, or a team dissolving, six of the possible 42 sessions from the 14 teams recorded teams had no video footage). Unfortunately, natural language processing was not possible given the bilingual nature of the gameplay, as well as multiple speakers with overlapping talk. Even with groups that did their best to remain in the target language, since the students are foreign language learners unfortunately the dialogue was not recognizable to automated programs, and the majority of transcription had to be manual⁶. Given the nature of the activity with participants interacting with each other as well as the learning tools, the first level of coding entailed identifying collaborative episodes regarding the target language, technology use, and gameplay. These coding units were identified at the episodic level; thus, coding could be a single turn or several consecutive turns between speakers (Volet et al., 2009). Additionally, these previously identified recurrent themes during gameplay were drawn from Perry's (2015) study:

⁶ I used the self-transcription mode of *transcribe* (available at transcribe.wreally.com) with integrated media player and editor for transcriptions.

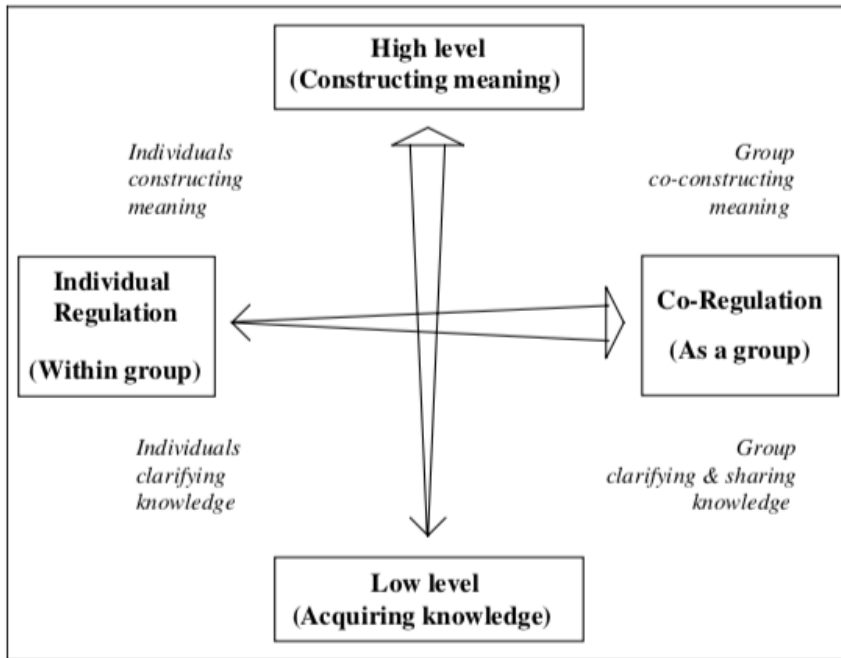
- *Language* - Interactions between students pertaining specifically to the *target language*: a learner helping a teammate regarding vocabulary, grammar, or pronunciation
- *Technology use* - Interactions specifically concerning the learning tool, students helping one another regarding some *technical* aspect of the tool
- *Gameplay interactions* - Collaborative interactions regarding *gameplay*

The results for this analysis showed the frequency of the identified types of collaborative interactions during gameplay.

3.5.3 Analysis of student gameplay video data for collaborative learning

This research also sought a deeper examination of collaborative learning and thus a means of capturing this through video data analysis was employed through the adaptation of Volet et al.'s (2009) CL framework. This analysis examines the ways L2 learners socially regulate and process content during gameplay (RQ4). As seen in Figure 7, this analysis of socially regulated learning combines the concepts of social regulation and content processing. The potential social regulation within a group of learners is shown by the horizontal bidirectional arrow representing a continuum from individual regulation within a group of learners to co-regulation as a group. The learner's potential content processing continuum is shown by the vertical bidirectional arrow representing low level content processing on one end, such as acquiring knowledge, to high level content processing (constructing meaning) on the other.

Figure 8. Collaborative learning framework



Note. Volet et al.’s framework for socially regulated learning, 2009, p. 131

The intersection of the two concepts creates four quadrants that indicate the principal dimension of social regulation (individual or group) and level of content processing (low or high) that can be observed while learners interact during the group activity. These four categories, which are identified in italics in Figure 7 are: low-level individual regulation, low-level co-regulation, high-level individual regulation, and high-level co-regulation. Given that high-level co-regulation is the most effective means of collaborative learning (Volet et al., 2009), this is visually represented in Figure 9 by the quadrant being intersected by the widest part of the arrows on the continuum.

Drawing on Volet et al.’s framework, a first level of coding at the episodic level was performed on the sample videos from Fran 160. Similar to Volet et al.’s the present research coded episodes according to the following definitions:

High-level content-processing episodes (individual or co-regulation) referred to engagement in elaborating, interpreting, reasoning, building on or linking ideas, explaining in one's own words, or help seeking for understanding.

Low-level content-processing episodes (individual or co-regulation) represent clarification of basic facts, from a written source or help seeking details.

Individual regulation (high or low-level content processing) represented episodes featuring only one speaker, other than minor inclusions from others such as an initial precipitating question, or acknowledgement tokens (e.g., “yep”, “uh huh”).

Co-regulation (high or low-level content processing) represented episodes in which multiple group members made verbal contributions. p.132

A pre-analysis of the data showed instances of all four quadrants during participant gameplay, showing that although the learning content differed greatly from Volet et al.'s study the gamified language systems also held potential for creating a learning environment in which students illustrated high-level content processing episodes. Therefore, I continued the adaption of the framework to suit this different learning context.

The adaptation of Volet et al.'s (2009) framework for a L2 gamified experience was an iterative process. Volet et al.'s study explored how high-level co-regulation in collaborative learning emerges and is subsequently sustained by employing video footage of veterinary science students during two meetings as they worked on a group assignment in the analysis of a clinical case. This research first coded the verbal interactions into two main categories: processing the clinical case and other matters (such as task-related matters and organization). For the present research, processing gameplay and other matters was therefore a logical first step. However, the present research entailed many additional elements, as the students were not only interacting with each other, but also with the learning tools. Volet et al.'s videos were coded solely on verbal interactions; however, many player interactions during the present research were not verbal;

especially when students were interacting with the tool. The added value of video footage offered the potential to code non-verbal instances of both low and high-level content processing. For example, when students were using online dictionaries or creating a tweet. Additionally, gameplay is not stationary, therefore students were physically moving to different locations; possibly interacting with their surrounding environment, each other, the tools, or walking in silence. Thus, the categories for “other” emerged as recurring themes were marked within the data (Brinkman & Kvale, 2015). Given that the objective was not simply playing the game, but that of exploring the campus in the target language, small talk in English was coded as *off task* and ultimately not included under the combined evolving “other gameplay” category to gauge to what extent students remained *on task*. Additionally, other stand-alone themes within the “other breakdown” bracket emerged that would allow for a more in-depth examination of the data: for example, students silently reading game content, silently walking between game content locations, and students seeking expert help when asking questions of a TA, professor, or librarian. This evolving analysis revealed the following empirically derived codes for the breakdown of content other than processing gameplay:

Other breakdown

- Off task – small talk in English
- Expert help – question posed to a TA, prof, librarian
- Silently reading game content
- Silent walking
- Other gameplay
 - small talk in French
 - not silent but also not enough content to code (less 10s bursts)
 - interacting with gaming interface but no dialogue to code
 - Time posting and tagging tweet after created
 - Watching game content videos

After this first level of coding and pre-analysis of the sample videos from Fran 160, the next stage was preparation for testing in Spring 2019. This included making necessary changes to both gamified systems for the next testing sessions gleaned from cohort 1 gameplay sessions (see Section 3.1). Following the completion of testing data set 2 and 3, I moved forward with transcribing and preliminary coding of the video data for all three cohorts. Additionally, I compiled questionnaire data, gaming platform data and Tweets for these two cohorts.

The next stage involved the selection process regarding the inclusion/exclusion for the close analysis of video data employing Volet et al.'s modified framework. The reviewing and preliminary transcription of Fran 100 playtesting videos showed that this cohort relied heavily on the accompanying language expert (researcher/TA) for game comprehension. A means to examine these types of interactions is shown in Sydorenko et al.'s (2019) analysis of AR language gaming with a language expert as a team member. However, the present research sought the close analysis of collaborative learning pertaining to the L2 students, therefore the data coding and analysis employing Volet et al.'s framework was restricted to data set 1 and 2 (Fran 160 and Fran 120); as these cohorts had either no accompanying language expert or limited interference from the accompanying researcher/TA. Fran 100 data was however employed to examine the student's perception of the learning experience (RQ1), which elements students identified as useful for language learning (RQ2) and how students collaborated to complete tasks (RQ3).

Additionally, as stated previously several team sessions were not successfully recorded either due to human error or technical issues. Student absentees also affected the consistency of team members from session to session (see Fran 160 and Fran 120 testing groups, Tables 3 and 4). Therefore, to remain as consistent as possible for the close analysis of CL, the teams that had

minimal or no changes for team members, as well as all three sessions recorded were included. This resulted in three of six teams from Fran 160, and three of five teams from Fran 120 selected for the next phase of video coding and analysis.

The detailed coding of gameplay processing mirrored Volet et al.'s protocol in that episodes had to be a minimum of 10 seconds in duration. If the episode was shorter than 10 seconds it was categorized within the longer episode in which it took place. As seen in Table 12 below spreadsheets were employed for the coding and analysis. Time stamps were placed in column A of the spreadsheet. This documented the start and finish times of each episode and was adjusted accordingly during the coding process. The transcript of student gameplay videos was copied and pasted into column B. Column C was used to insert the markers identifying each type of episode. This included the four gameplay processing codes, low-level individual regulation (IND LOW), low-level co-regulation (CO LOW), high-level individual regulation (IND HI), and high-level co-regulation (CO HI), as well as the additional markers mentioned above (off task [OT], expert help [EX], silent reading [SR], silent walking [SW], other gameplay [GP]). In column D I logged the duration of each episode in seconds. Column E documented the collaboration type; language (CO LANG), technology use (CO TECH) or game interaction (CO GP). Column F was used to record researcher notes.

Table 12. Spreadsheet coding example Fran 160

A	B	C	D	E	F
Time	Transcript	Code	duration	CO type	Notes
Time stamp documenting when an episode starts and finishes	transcription of student gameplay	markers for episodes: OT, EX, SR, SW, GP, IND LOW, IND HI, CO LOW, CO HI	length of episode in seconds - minimum 10s	markers for type of collaboration: CO LANG, CO TECH, CO GP	Researcher notes from observing video
8:04-9:33	oui donc c'est un radio journal	CO LOW	89	CO GP	Clarifying game instructions- IND HI episode less than 10s
	donc il faut considérer ton âge ton profession				
	pas notre âge, il faut lui demander son âge				
	non non pour nous.. parce que le célébrité francophone de uvic...il a.. il a besoin de notre information				
	oh <i>notre</i>				
	oui				
	en français				
	oui				

Similar to Volet et al.'s research, the demarcation of the episodes and the identification of the type of interaction observed in the episode were done simultaneously. Some sections needed multiple viewings to identify the shift from one category to the next in order to document the episodic boundary. Additionally, at times during a first viewing it was not always clear in which category an episode should be categorized. These were highlighted and I would review them again at a later time. The example for each column in Table 12 shows an excerpt of the transcript for an episode from session 2 Fran 160 team Bleu C. The episode consists of the students clarifying the gaming instructions. One student has misunderstood the instructions, and displayed in bold text another team member explains the instructions again in his own words. Explaining in one's own

words would fall under high-level content-processing; however, since this episode is shorter than 10 seconds it is categorized within the longer episode (CO LOW) in which it took place, as per Volet et al.’s protocol.

Once the video transcript had been coded, I employed the spreadsheet filter function to column C to compile the episodes by category, and use the relevant data in column D to calculate the sum of the episode durations. The sum of each category was recorded and then divided by the total duration of gameplay for said team (also in seconds), in order to calculate and document the percentage of time spent on each category for each session and team. For example, Table 13 shows Fran 160 team Bleu C’s percentage of time per category for all three sessions:

Table 13. Example of percentage of time spent per category

Bleu C	S1	S2	S3
Processing gameplay	85.7	72	65.9
Other breakdown			
Off task	11.1	0.7	7.8
Other gameplay	5.5	16.5	23.9
Expert help	1.2	5	2.7
Silently reading game content	0	0.8	0.4
Silent walking	5.2	9.8	4.7
Breakdown by dimension			
Content processing			
Total high-level	28.7	29.9	21.4
Total low-level	57	42.1	44.5
Social Regulation			
Total individual regulation	28.8	11.5	20.6
Total co-regulation	56.9	60.5	45.3
Full breakdown			
High-level co-regulation	16.1	23.4	14.2
High-level individual regulation	12.6	6.5	7.2
Low-level co-regulation	40.8	37.1	31.1
Low-level individual regulation	16.2	5	13.4

As seen in Table 13, in session 1 (S1) Bleu C team members were processing gameplay 85.7% of the gameplay time. The other breakdown comprises 23% of the time. The analysis of video footage allowed me to document overlapping episodes with team members participating in different categories at the same moment; therefore, the sum of these is not 100%, but instead 108.7%. For example, I observed several overlapping episodes during this team's gameplay consisting of one team member composing tweets individually on camera while walking between locations (therefore high-level individual regulation), while the other two team members were casually conversing in French; however, since their small talk was not game related it was therefore coded as "other gameplay".

3.5.4 Analysis of student gameplay video data for learning context

This research also examined what this type of experience means specifically for language learning. Additional coding of the video data contained markers to document how language learners interact as a group in the AR environment (RQ5). Thus, transcriptions were coded in order to account for the following:

- duration of gameplay
- percentage of time on and off task
- lapses of silence (lasting 10 seconds and longer)
- use of an online dictionary
- percentage of French vs English spoken during the task
- the number of times two or more group members laughed during gameplay
- tweets

The duration of gameplay was noted within the video length to document set-up time, as well as measure gameplay progress of teams to allow a comparison with other teams; within the same

cohort, as well as between cohorts (adapted from Perry's 2015 study). Given that these mobile systems require students to navigate between physical locations, lapses of silence during gameplay were addressed in Perry's (2015) study. As mentioned previously (see section 3.1.4.5) additional game elements were added to this gaming iteration to potentially address this, and therefore also documented. The language spoken by players was coded, and then a word count used to determine the percentage of French versus English spoken during the task (created for this study). Group cohesion is likely to affect collaboration, and therefore also relevant. To this end the number of times two or more team members laughed together was coded. This draws from Nasir et al.'s study (2015) in which laughter of two or more members within a group during gameplay was documented as a means to analyze group cohesion.

3.6 Data illustrations

Presented in the form of excerpts, below are illustrations of each of the four categories: individual or co-regulation and high or low-level content processing. Each example is described in terms of consistency pertaining to the category for which it portrays. The vast majority of low-level individual regulation episodes consisted of one team member reading gaming content out loud to the rest of the team.

Excerpt 1: Low-level individual regulation team Vert A Session 2 (Video 1- 21:14-21:57)

Kylie⁷ (participant S19P4): Rebonjour! Oh *that's* cool *re...*bon jour! Êtes-vous prête à trouver le livre?

⁷ All names have been changed to respect the anonymity of the participants

Ella (participant S19P1): Oui continuez!
Kylie: Vous utilisez le lien à la bibliothèque pour chercher le livre...
Ella: Uh huh
Kylie: ok oh...so it's PQ22681...Ok ok...Ensuite il y aura un lien pour le livre nous
cherche...il y a deux options à utiliser... un texto avec la côte sera envoyé sur votre
portable... une carte de la bibliothèque qui vous montrez où se trouve le livre...Ok.

In excerpt 1 Kylie is reading the onscreen gaming content to the rest of her team out loud. Ella reads only one line, and then interjects with a brief affirmative response. Therefore, such instances were coded as low-level individual regulation, as they were all or mostly verbatim reading, and did not demonstrate clear evidence of meaning making or knowledge construction.

Low-level co-regulation instances included multiple speakers, and often pertained to clarifying gameplay content, making decisions prompted by the system or for gameplay progression. In excerpt 2, the participants from two teams (Rouge C and Vert C) are interacting while in the campus library.

Excerpt 2: Low-level co-regulation team Rouge C Session 2 (Video 3- 5:14-6:14)

Miles (F18P27 Rouge C): Ok thank you very much! Merci!... Yeah, I totally know what this means...[All laugh]
Eva (F18P17 Vert C): Do you know where to go?
Alice (F18P6 Rouge C):Yes
Sadie (F18P16 Rouge C): This way! [points in direction of the stairs]
Eva: Ok we'll follow you.
Miles: Tricheur! [All laugh]
Lisa (F18P9 Vert C): You just asked the librarian!
Miles: Do you guys know how the library works?
Eva: Kind of... do you know what floor it's on and stuff?
Miles: It's on the 3rd floor.
Tara (F18P11 Vert C): Ok over there then.
Alice: Ok
Eva: Yeah... I kinda know...
Tara: it's up there [points further up staircase]
Alice: There's a map up there we can look at.
Sadie: Yeah
Lisa: Yeah we'll look up there.

Miles: Also, we have to do an audio recording once we find it, but it's third floor of the library, so *that's* good! [All laugh]
Alice: Really?
Miles: Yeah, we'll take it to second floor then we'll like bring it back.
Lisa: Do you have Sophie as well?
Miles: Sophie? No, we have Pierre.
Lisa: No, but you know as the guide... oh never mind that was the other game.
Eva: This way? [points to third floor door]
Alice: It's this way
Sadie: Yes here
Eva: Ok

In extract 2, Miles has just finished asking the librarian where to find the book *Les Misérables* for the *Explorez Quest Trouver un livre*. As his team (Rouge C) walks towards the staircase, Eva, a student from another team (Vert C), asks if they know where to go. The group interactions as the two teams go to find the book is not co-construction of knowledge, but clarifying facts, such as where to go, and sharing pre-existing knowledge (such as Alice sharing that there is a map on the third level of the library). Therefore, it was coded as low-level content processing. The instance also illustrates interactions between multiple contributors, characterised by the speaker frequently changing, short turns, and similar amounts of contribution, indicators for the episode to be coded as co-regulation on the social spectrum.

High-level individual regulation instances often pertained to a team member creating a tweet individually (either orally or written) or a team member explaining the requirements of a task to their teammates. In the following excerpt 3, team Rouge A has just read the directions for the second task in the *Quest Trouver des services en français*, and Julie (participant F18P14) leads her teammates to the French department office since she knows where it is located.

Excerpt 3 High-level individual regulation team Rouge A Session 3 (Video 5 7:55-8:25)

Julie: [looking at the information on the office door] C'est ouvert um...sept heures...trente à...trois heures trente... Est-ce qu'on a besoin de tweeter ça?...Est-ce que c'est la question? [teammate holding phone turns it towards Julie so that she can reread gaming prompt] ...puis quelles sont les services offert ...ok oui [turns back to office door looking for additional information] quelles sont les services...quelles services? oh je ne sais pas.

The length of Julie's turn in excerpt 3 resulted in the instance being coded as individual. She is thinking out loud and attempting to understand what the task requires. When her teammates remain silent (they also appeared to be trying to understand the instructions), she rereads the quest prompt and then subsequently answers her own question. She then returns to the door seeking additional information. This contribution was coded as high-level content processing given that the student is deducing what the task requires, reasoning out loud, and linking ideas. After her final comment "oh I don't know" her teammates then joined in, and the following instance was coded as high-level co-regulation as the students worked together figuring out the resources offered by the office and then creating the tweet.

High-level co-regulation instances illustrated co-construction of knowledge with multiple contributors. High-level co-regulation content processing episodes emerged when students responded to certain gaming prompts, as well as open ended questions. A large majority of instances arose during the task of creating a twitter post, which often resulted in the students first discussing the content they should include, and then creating the tweet. In the following example, excerpt 4, team Bleu C is working on completing the Quest *Mystic Market* (also the name of where the Quest takes place, which has ten food kiosks). The in-game character has informed the players that the French celebrity likes spicy food, and has asked them to order a starter, a main dish, and a dessert.

Excerpt 4 High-level co-regulation team Bleu C Fran 160 Session 3 (Video 3 13:22-14:49)

Dave (participant F18P1): Donc...on doit commander une entrée, un plat principal et un dessert...uhhh...Pour dessert...uhhh [looking around at the kiosks]
Chris (participant F18P26): les waffles?
Dave: Oui [All laugh]
Jade (participant F18P35): Oui
Dave: Oui, il peut manger un waffle...
Chris: C'est pour petit déjeuner non?
Dave: ...avec du syrup
Chris: Oui oui
Jade: ...pas juste pour le petit déjeuner
Dave: Uh...et pour le premier cour...uh...
Chris : Quelque chose épicé?
Dave: Oui
Jade: Oui
Chris: C'est le le...[looking around at the kiosks] le... thaï le thaï c'est épicé
Jade: Oui le thaï ou...
Dave: Oui il peut manger la nourriture thaï
Jade : Il peut manger...un hamburger? [others laugh]
Dave: un burger?
Chris : Un hamburger? [laughter continues]
Jade: What?
Dave: Mais il aime les plats épicés, pas des hamburgers, ce n'est pas...umm ce n'est pas épicé...
Jade: Hmm?
Chris: Épicé...*spicy*
Jade: Oh! *Spicy* oh d'accord! D'accord! [All laugh]
Chris : What? [imitating Jade, then laughs]
Dave: hmm un hamburger?
Jade: You can make it spicy! [Laughter continues]
Dave: I mean you're not wrong!
Chris: Alors un hamburger très épicé? Oui?
...
Dave: Ok après le premier cours... il peut manger un hamburger avec beaucoup des épicé...[Laughter continues]
Jade: avec tabaco sauce [All laugh]
Dave: ...le poivre et le sel
Jade: Le tabasco! [Laughter continues]
Dave: Oui un sauce tabaco
Jade: Non non pas sauce tabaco... sauce tabasco un sauce tabasco [Laughter continues]
Chris: *une* sauce
Jade: D'accord avec *une* sauce tabasco

Dave: ...et pour un entrée? Umm on peut manger...[looks around at the kiosks]
uhh... oh! Le soupe!
Chris : La soupe? Oui, c'est ça, ça marche
Dave: La soupe... uh le wild thai chicken?
Chris: Oui oui le poulet
Dave: Ah oui oui le poulet thaï d'accord...
Jade: It's so good
Dave: Yeah so good! Ok, C'est bon!

In excerpt 4, the students are working together drawing from what they see in their environment around them to answer the task proposed by the system. They build on each other's ideas and employ reasoning skills. The students also assist each other with several examples of corrective feedback. For example, Jade has not understood the meaning of *épicé* (spicy) and therefore at first does not understand why her teammates find her suggestion of a hamburger funny. Dave attempts to explain in the target language, but when Jade expresses she still does not understand, Chris offers the translation in English. Jade then joins her teammates in laughter but follows up with the reasoning that they can make the hamburger spicy. Additionally, Chris offers corrective feedback to his teammates on several occasions. For example, he suggests correct definite and indefinite articles (*une* sauce, *la* soupe), as well as the French word for chicken. In each instance the other student repeats back the correction, acknowledging that they have heard and understood the feedback. Furthermore, the episode illustrates the speaker frequently changing with short turns, and similar amounts of contribution by the participants. This is in correlation with Vauras et al.'s (2003) description of shared regulation with multiple team members involvement of a goal-oriented reasoning process.

In order to employ the adapted framework and explore collaborative learning by means of tracking the emergence of high-level co-regulation during gameplay, the data was examined by

three means: the focus of interactions during gameplay; patterns regarding the emergence of high-level co-regulation; and contributing factors to sustained high-level co-regulation.

This chapter described the gamified learning tools *Explorez 2.0* and *VdeUVic*. The design and development stages of both tools was also detailed, as well as certain challenges encountered, and the steps taken to overcome these. Next, the methodology of the study was described, notably the participant profiles, data collection methods, procedure, and data analysis. Details regarding the adaptation of Volet et al.'s framework were provided, as well as data illustrations discussing the four quadrants. The next chapter will discuss the study results in correlation with the research questions.

Chapter 4. Findings

4.1 Player experience details

To examine the students' perceptions on their learning experience with the gamified tools (RQ1), as well as ascertain which elements the participants identified as useful for language learning (RQ2), descriptive statistics of the post-questionnaire and transcribed interviews were employed (see the map of the research questions in section 3 *Methodology* Table 1).

In the post-questionnaire participants were asked to describe their experience with both gamified tools. The three groups top descriptors for *VdeUVic* were “fun”, “interactive”, and “relevant”. In regards to *Explorez*, the top descriptors were fun, useful, and interactive (Table 14).

Table 14. Participants responses describing their experience with the tools

	VdeUVic			Explorez		
	Fran 160	Fran 120	Fran 100	Fran 160	Fran 120	Fran 100
Motivating	8	3	3	4	4	3
Demotivating	0	1	0	2	0	1
Relevant	3	4	4	9	4	4
Irrelevant	5	1	0	3	0	0
Useful	7	3	1	6	9	4
Useless	2	2	0	1	0	0
Fun	19	4	2	16	8	4
Boring	2	2	0	2	0	0
Interactive	14	5	3	15	8	6
Other	3	2	1	4	0	0
N	23	11	6	23	11	6

Participants were asked to rate their overall experience for each gameplay session on a Likert scale from 1 to 5 (1=very poor 5=very good). The option of not applicable (N/A) was also included in order that participants who had missed a gaming session could respond so as needed. Overall player experience fell within the positive end of the spectrum, varying for each cohort. As seen in Table 15, the Fran 160 cohort’s lowest rating was for their first session with *Explorez*, which is not surprising given the many technical (and gameplay scaffolding) issues this cohort encountered during the testing session. The Fran 120 and Fran 100 cohorts rated the *VdeUVic* session lower than those with *Explorez*. From interview feedback, we can infer that the amount of unknown vocabulary, which affected comprehension likely played a role. The Fran 160 mean of 3.4 for their experience with *Explorez*, in comparison to other two cohorts (Fran 120 and Fran 100) combined mean of 4.1 suggests that the iterative development improved the player experience.

Table 15. Overall player experience rating per session of gameplay

	Session 1 VdeUVic			Session 2 Explorez			Session 3 Explorez		
	Fran 160	Fran 120	Fran 100	Fran 160	Fran 120	Fran 100	Fran 160	Fran 120	Fran 100
N/A	0	0	1	0	0	0	1	1	0
1 (very poor)	0	1	0	0	0	0	0	0	0
2 (poor)	3	2	0	3	1	0	1	1	0
3 (satisfactory)	7	3	2	9	0	1	8	1	1
4 (good)	12	5	1	10	7	3	12	8	3
5 (very good)	1	0	2	1	3	2	1	0	2
N	23	11	6	23	11	6	23	11	6
mean	3.5	3.1	4	3.4	4.1	4.2	3.6	3.7	4.2

4.1.1 Participants identified strengths and limitations of the tools

Further information regarding player experience was provided during the interviews. The top recurring responses to the questions “[w]hat would say are strengths of the tools/games or what did you like?” pertained to being outside of the classroom and the location-based aspect, as well as gaming elements. Twelve of 21 participants discussed the opportunity to be out of the classroom for their L2 learning, and how the place-based gameplay element added to their experience.

Following are four such participants comments:

What I really like being able to use it to explore different ways of speaking French outside of the classroom. I think it's a really *really* good tool. (Fran 160 participant F18P29)

I liked how interactive it is and working together with your team and communicating ...and being out of the classroom and applying different French ideas and words to the environment around us. (Fran 120 participant S19P7)

I liked getting outside and speaking French in a more relaxed atmosphere...the games made it more memorable and a fun way to learn. (Fran 160 participant F18P24)

I really liked the new learning environment. It was nice to apply what we had been doing in the classroom to a completely different setting...We were interacting with each other and the game and using it in a very *applicable manner* if you will. (Fran 100 S19P18)

As the excerpts above attest participants reported the gamified tools added benefits to their L2 learning, such as creating a collaborative, more relaxed learning environment, and a contextual learning experience outside the classroom.

Additionally, eleven out of 21 participants elaborated on which game elements they appreciated the most such as quests, AR feature, badges, or characters. The most mentioned game element was the narrative, and how the story added to the experience. For example, one participant elaborated:

I really *really* liked the story! I'm a big fan of stories, and progressing through story, and I like video games in general so that probably helps a lot. But I like that there were stakes to the game. It wasn't pointless, it had a story that built whenever you would go do a part. There was an item you got, and then it helped build the story, and then the characters would come up and talk to you, and they would build to the story. It all felt like I was working towards a progressive finale. I was working towards something, which was nice, and I really appreciate that! (Fran 160 participant F18P1)

Other student responses pertained to collaborating with teammates, the novel learning opportunity, and the repetitive nature of gameplay in both systems contributing to vocabulary learning.

On the other end of the spectrum, participants were also asked “what didn’t work well? What if anything would change and/or remove? What didn’t you like and why?” In the Fran 160 cohort most students’ answers paralleled their responses to the question regarding constraints or issues they had with the tools. The participants mostly mentioned technical issues, and/or the Twitter app crashing. When delving deeper, some of the described technical issues were in fact a gameplay design scaffolding issue regarding triggers and GPS display (see section 4.1.3 *Issues during gameplay*). However, video data also showed instances of teams needing to reload the game due to the system freezing or Twitter.com crashing.

Other participants discussed comprehension issues when commencing gameplay, which was also affected by the fact that the instructions were in the L2. This was also seen in the video analysis and was prominent with several teams whose members were limited in gaming experience. However, another factor was the time players were willing to spend reading and working together to understand the instructions, not every team with limited gaming experience struggled with gameplay comprehension. As mentioned previously, this type of feedback resulted

in the creation of the tutorial videos, as well as simplifying the gaming options, and streamlining gameplay during the introduction for the next cohorts.

The Fran 120 and Fran 100 cohort participants for the most part offered different feedback that did not mirror their previous responses regarding constraints or issues with the tools. The issue of the amount of unknown vocabulary in *VdeUVic* resulting in comprehension issues was raised. Other feedback pertained to difficulties hearing the audio of the game avatars in busy locations, which was a matter raised by participants from all three groups. Video data analysis showed this was the case for other teams as well. Some participants expressed not liking Twitter, and when asked to expand on this, some students felt “it was a pain to use” while others “didn’t see the point of it”. These comments are further supported by the lower rating of usefulness regarding Twitter in the questionnaires by all three cohorts (see Table 16).

Finally, one participant from Fran 160 felt the French content was below his level, and therefore not challenging enough (though he went on to say it was perhaps the correct level for his classmates), this participant also said this type of activity was better suited for high school than university level students. He was the oldest participant in the Fran 160 cohort, between 36 and 40 years old. In contrast, the one participant in the Fran 120 cohort who was between 41-50 years old was overall very positive about the experience. She did say that some technical aspects were “a bit of a challenge” for her, but that she relied on her younger teammates for technical assistance with the tools. Gamified systems will not appeal to all learners. However, the above highlights that age and gender are not the relevant factors, instead the individual’s inclinations (such as learning styles, attitude towards technology and games), as well as the system needing to be well-developed play important roles in the learner’s experience.

4.1.2 Participants rating of gamified tools usefulness as a FL2 learning activity

Participants were asked to rate how useful the gamified activities were overall as a French language activity. On a Likert scale of 1-5 (1=useless and 5=very useful) participants rated *VdeUvic*, *Explorez* and the task of tweeting audio/video recordings and/or other gameplay content. As seen in Table 16, 52.17% of the Fran 160 participants reported *VdeUvic* as useful for language learning, 52.17% reported *Explorez* as useful or very useful, and 39.13% stated using Twitter to post game content and recordings as a useful language activity.

Table 16. Participant rating of tools as useful as a French language activity

	VdeUvic			Explorez			Using Twitter		
	Fran 160	Fran 120	Fran 100	Fran 160	Fran 120	Fran 100	Fran 160	Fran 120	Fran 100
1 (useless)	0	0	0	0	0	0	0	2	1
2 (mostly useless)	1	3	0	1	0	0	6	1	3
3 (neutral)	10	2	2	10	1	1	8	4	2
4 (useful)	12	5	3	10	8	4	9	3	0
5 (very useful)	0	1	1	2	2	1	0	1	0
N	23	11	6	23	11	6	23	11	6
mean	3.48	3.36	3.83	3.57	4.09	4	3.13	3	2.17

In the Fran 120 cohort, 54.6% reported *VdeUvic* as useful or very useful as a French language activity, 90.9% reported *Explorez* as useful or very useful, and 36.4% stated using Twitter was useful or very useful. In regards to the Fran 100 cohort, 66.7% reported *VdeUvic* as useful or very useful for language learning, 83.3% reported *Explorez* as useful or very useful, and 0% found tweeting to be a useful language activity. As mentioned previously, only the Fran 160 group was already using Twitter for class activities, which would influence their responses either

negatively or positively. The majority of participants in the other two groups had never before used Twitter, thus the testing sessions were their first experiences with the microblogging service. Overall, *Explorez* was rated as the most useful as a French language activity by all three cohorts, and Twitter's usefulness as a language activity was rated the lowest by all three groups.

4.1.3 Issues during gameplay

Highly relevant to participant experience are potential difficulties encountered during gameplay. Participants were asked if they encountered any difficulties during the gaming sessions (such as technology issues, comprehension, Twitter use, etc.). Overall, twenty-four of the 40 participants (60%) responded "yes" to this question. In the Fran 160 cohort 15 of 23 participants reported (65.2%) a form of difficulty, with the majority pertaining to technical issues. Some participants experienced the game crashing or freezing, several reported the in-game Twitter function crashing or difficulty using Twitter to make an audio recording. Other technical issues specified were problems with game triggers or inaccurate GPS locations displaying.

The video data and participant interviews provided further information, and some issues that participants reported as technical difficulties, such as certain game triggers and GPS issues were in fact design scaffolding issues. For example, GPS player location at indoor gaming locations is in fact not relevant to gameplay in *Explorez 2.0* because all location dependant indoor triggers were upgraded to AR to make them stable. However, on several occasions, groups of players in this cohort did not recall this information, and when they found game progression to be unclear these participants thought the game was malfunctioning since the map view showed their GPS location inaccurately. The necessary directions for game progression were available in the

Quest tab; however, for most participants not versed in digital gaming this proved insufficient gameplay scaffolding. Therefore, all such gaming location cues were immediately addressed before the next gaming session by adding additional in-game hints that automatically popped up or by changing the trigger for player progression to include an accessible hint.

However, as the first testing group this cohort did encounter the most technical issues, which were resolved as best as possible before the next session, such as removing the Twitter function in-game and instead having players navigating to the Twitter app. Participant gaming experience and knowledge also impacted player experience. Six of the 13 participants interviewed from Fran 160 mentioned some confusion at the start of gameplay, however four of these participants stated that their comprehension was also impacted by the fact that gameplay was not in their first language. These participants were not versed in digital gaming, and this feedback reinforced the need for the gaming and Twitter tutorials for the next two cohorts. On the other end of the spectrum, when a student with gaming experience was asked about constraints and issues with the tools he commented “[w]e didn't really encounter any bugs...we just followed the steps and it worked fine. It's pretty self-explanatory, it works the same as most gaming applications” (Participant F18P1).

In the questionnaire the Fran 120 cohort reported fewer difficulties than the previous group with five of 11 (45.45%) participants stating they encountered an issue. Three participants reported technical issues (an instance of the system crashing or freezing) two participants stated they had gameplay comprehension issues, and one participant commented on the difficulty of vocabulary in *VdeUvic*. The tutorial videos appeared to assist in user comprehension but were not a fix all for all students. Group cohesion and player type, as well as gaming experience as mentioned before

also impacted usability. In this cohort one participant with no digital gaming experience mentioned some confusion at the beginning of gameplay; however, she went on to explain that working with her group regarding the French vocabulary, as well as the gaming content, they successfully figured things out as they progressed. Another participant however that did not have such a positive experience within her group, and again with no gaming experience, mentioned her team members pushing through screens and text when they did not understand the content. Participant S19P16 “I think when we were playing the game, we didn't really know what most of the words were. I feel like we also weren't really trying too hard, and it was very easy to just press buttons and be like ‘I think that's what it is’.” This comment speaks to both group cohesion and player types. She stated later in the interview that had she known her teammates better she felt they would have been more likely to collaborate.

In the Fran 100 cohort four of the six participants reported a form of difficulty. However, this cohort stated technical difficulties were minor for the most part (i.e. “small bugs that didn’t affect gameplay” participant S19P21). This cohort was very well versed in technology and four of the six participants had extensive gaming experience. In regards to gameplay and usability participant S19P21 stated “it has really good content, game mechanics and reward system”. Another participant commented “it’s relatively straight forward with clear instructions and offers players two or three options at a time” (participant S19P18). However, Fran 100 students struggled with the higher level of French needed for gameplay comprehension. This often resulted in relying on the accompanying TA for language comprehension, though participants also employed the in-game dictionary, as well as working with their teammates.

4.1.4 Participants rating of gaming elements as learning motivators

Additionally, in order to appeal to the largest demographic possible, *Explorez* includes a diverse range of game-elements (see section 2.5 *Mobile AR and collaborative language learning*). The students were asked to rate six of these elements as learning motivators in regards to their experience with *Explorez*: the treasure hunt aspect and exploring the campus, completing quests, collecting badges, collaborating with teammates, interacting with game content (characters, videos, objects) and tweeting recordings and game content. Students were asked to choose a response on a 5-point Likert scale with 1 indicating the element was “negative-it was demotivating”, and 5 indicating the element was “positive-it motivated me in my learning”. As seen in Table 17, Fran 160 rated collaborating with teammates the highest with 91.3% stating it encouraged or motivated them in their learning. Next, 78.3% of this cohort rated completing quests as mildly positive or positive as a learning motivator. In regards to Fran 120, 100% of participants reported that collaborating with teammates, interacting with game content, and completing quests either encouraged or motivated them in the learning. For the Fran 100 cohort, 100% of participants reported that collaborating with teammates was mildly positive to positive as a learning motivator, and 83.3% of participants stated that the treasure hunt aspect and exploring the campus in French encouraged or motivated them in the learning. All three groups rated collaborating with teammates as the highest learning motivator regarding their learning experience with the treasure hunt aspect/exploring the campus and completing quests a close second. Twitter was rated the lowest in regards to learning motivation.

Table 17. Participants rating of gaming elements as learning motivators

	Treasure hunt aspect- exploring the campus in French			Completing quests			Collecting badges			Collaborating with teammates			Interacting with game content (characters, videos, objects)			Tweeting recordings & game content		
	Fran 160	Fran 120	Fran 100	Fran 160	Fran 120	Fran 100	Fran 160	Fran 120	Fran 100	Fran 160	Fran 120	Fran 100	Fran 160	Fran 120	Fran 100	Fran 160	Fran 120	Fran 100
1 negative - it was demotivating	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
2 mildly negative - it was a distraction	0	0	1	2	0	1	3	1	1	1	0	0	3	0	1	7	4	1
3 none - it made no difference	8	1	0	3	0	1	7	2	1	1	0	0	5	0	1	8	2	2
4 mildly positive - it encouraged me in my learning	11	6	2	15	8	0	10	4	1	13	6	1	14	8	1	7	4	2
5 positive - it motivated me in my learning	4	4	3	3	3	4	3	4	3	8	5	5	1	3	3	1	1	0
N	23	11	6	23	11	6	23	11	6	23	11	6	23	11	6	23	11	6
mean	3.83	4.27	4.17	3.83	4.27	4.17	3.57	4	4	4.22	4.45	4.83	3.57	4.27	4	3.09	3.18	2.83

4.1.5 Gaming elements identified as useful for L2 learning

Participants were also asked to identify which elements in *Explorez* they felt were useful for language learning. The top responses were collaborating with teammates, the treasure hunt aspect and exploring the campus in French, as well as interacting with game content (characters, videos, objects). As seen in Table 18, 69.6% of Fran 160 participants stated collaborating with teammates as useful for language learning, and 47.8% identified interacting with game content as beneficial. Regarding the same question, 81.8% of the Fran 120 cohort reported the treasure hunt aspect and exploring the campus in French as useful for language learning, and 63.6% stated interacting with game content as useful. In the Fran 100 group 100% of the participants stated collaborating with teammates as useful for L2 learning, and 83.3% reported the treasure hunt aspect/ exploring campus in French as beneficial. For this question the first and second top responses differed for each group, highlighting the important of a range of different elements in gamified learning environments.

Table 18. Gaming elements identified as useful for L2 learning

	Fran 160	Fran 120	Fran 100
Treasure hunt aspect- exploring the campus in French	10	9	5
Completing quests	8	4	3
Collaborating with teammates	16	6	6
Narrative	8	3	2
Interacting with game content - characters, videos, objects	11	7	3
Tweeting recordings & game content	8	1	0
None of the elements are useful for language learning	0	0	0
Other (please specify)	1	0	1
N	23	11	6

Additional questions were also asked regarding Twitter’s effectiveness, and participant satisfaction using the tool for the designated tasks. Students were asked how effective the use of Twitter was for posting game progress and communicating with other players during *VdeUVic*. As seen in Table 19, in the Fran 160 cohort 78% responded somewhat effective or very effective. In the Fran 120 cohort 64% reported somewhat or very effective, and only 17% (one participant) of the Fran 100 students responded somewhat effective.

Table 19. Effectiveness of Twitter

	Fran 160	Fran 120	Fran 100
Extremely effective	0	0	0
Very effective	4	2	0
Somewhat effective	14	5	1
Not so effective	5	2	2
Not at all effective	0	2	2
N/A Our team used memos instead	0	0	1
N	23	11	6

Note. Effectiveness of posting game progress and communicating with other players

Participants were also asked how they felt about using Twitter to make audio or video recordings for the gameplay tasks during *Explorez*. As seen in Table 20, in the Fran 160 group 26% of the students were dissatisfied or very dissatisfied using Twitter, 18% were dissatisfied in the Fran 120 group, and 34% in the Fran 100 group were dissatisfied or very dissatisfied using Twitter for gameplay recordings. Therefore, the majority of students responded on the positive end of the spectrum regarding Twitter’s effectiveness for gameplay takes, and most of the students were not dissatisfied in using the tool for the activities. Twitter was simply rated the lowest when it was compared to the other gaming elements.

Table 20. Satisfaction using Twitter to make video or audio recordings

	Fran 160	Fran 120	Fran 100
Very satisfied	0	1	0
Satisfied	6	5	2
Neither satisfied nor dissatisfied	11	3	1
Dissatisfied	5	2	1
Very dissatisfied	1	0	1
N/A Our team used memos instead	0	0	1
N	23	11	6

4.1.6 The relevance of ‘place’ as identified by the participants

Participants were also asked if ‘place’ added to their learning experience. Nineteen of the 21 students responded “yes” that being outside of the classroom, in real environments (although only virtually francophone) aided in making their learning more relevant or meaningful. The participants also elaborated discussing the benefits of being outside the classroom and practicing their French in real world environments:

Definitely yes, because it is so different than what we usually get in a lecture class. You will remember it because of the *experience*, the environment...it helped me a lot for learning French. (Fran 100 participant S19P21)

Absolutely! It added a very real aspect to the learning...it brought us outside of the classroom to *very real events*, and we’d apply what we’d learned. (Fran 100 participant S19P18)

Yes, I was happy to be out of the classroom, and then it was interesting because I didn't think I'd remember some of the new words, but just because I kept reading them, and we were in real... relevant places I *did* remember them. (Fran 120 participant S19P13)

I absolutely loved it!...I think it makes it really fun being able to get out of the classroom, and go out into the world to practice our French...and I think it really helped me, I mean I

know the campus isn't francophone apart from the AI world, but it was nice and it also added a sense of realism to the game because we actually had to traverse real distances and go to real places that exist in the world to interact with the AI and the quests there...and being outside and going around definitely added to my interactivity and immersion. (Fran 160 participant F18P1)

The above excerpts highlight the students reported added value of being out of the classroom, and the gamified tools incorporating real world locations for their L2 learning, creating an immersive, contextual, and engaging learning environment.

4.2 Participants collaborative interactions: L2, technology and gameplay

The main goal of this research was to study collaborative L2 in gamified environments, therefore this study examined how students collaborate in order to complete the tasks (RQ3). This data analysis involved descriptive statistics of the video recordings of student gameplay (see the map of the research questions Table 1, section 3 *Methodology*). This analysis showed in what ways students collaborated to complete the tasks and permitted a comparison of team interactions to examine collaborative patterns. The nature of the gameplay activities entailed participants interacting with each other as well as the learning tools. Therefore, the first level of coding identified collaborative episodes regarding the target language, technology use, and gameplay. These coding units were identified at the episodic level, and coding could be a single turn or several consecutive turns between speakers (Volet et al., 2009). These previously identified recurrent themes during gameplay were drawn from Perry's (2015) study:

- *Language* - Interactions between students pertaining specifically to the *target language*: a learner helping a teammate regarding vocabulary, grammar, or pronunciation
- *Technology use* - Interactions specifically concerning the learning tool, students helping one another regarding some *technical* aspect of the tool

- *Gameplay interactions*-Collaborative interactions regarding *gameplay*

The results for this analysis showed the frequency of the identified types of collaborative interactions during gameplay.

4.2.1 Fran 160 participants collaboration

As seen in Table 21, when examining the available data overall for Fran 160, students collaborated regarding language interactions from 0-17 times per session with a total of 80 such interactions. This is an average of 5.3 times per team per session during gameplay (of the 15 recordings). Students assisted each other with vocabulary, grammar, or pronunciation in the target language. Many of these interactions pertained to vocabulary, with a more advanced student assisting a teammate that sought the translation of a word to comprehend gameplay or answer a question prompted by the system. The in-game pop up vocabulary questions also often resulted in students conversing to decide the correct response, and at times even debating to support their answer.

Regarding a technical aspect of the tools, Fran 160 participants collaborated 0-14 times per session with a total of 56 interactions, which is an average of 3.7 times per team per session. Students assisted each other with navigating the user interface, interacting with gaming objects, and using the Twitter functionality for making voice recordings.

Collaboration regarding gameplay interactions, students interacted 3-35 times per session for a total of 286 times. This is an average of 19.1 times per team per session. Participants assisted each other with gameplay comprehension; for example, more advanced students repeating the gameplay task instructions in their own words to teammates who were unclear regarding what the task entailed. Participants discussed the gaming content, and next steps for gameplay progression,

deciding how to proceed, as well as making specific choices prompted by the system. Students more familiar with the campus assisted their teammates with directions when looking for physical locations, and some students worked together using the map function to figure out the next gameplay location. Additionally, participants worked together to complete tasks; for example, discussing a Twitter post's content before commencing the recording, and then at times also dividing the task amongst themselves so that each participant addressed an element of more complex tasks, thus each one contributing a portion of the necessary response to the recording.

Table 21. Collaboration type Fran 160

Teams	Collaboration		
	Language	Tech	Gameplay
Bleu A			
S2	11	7	24
Bleu B			
S1	4	2	16
S2	4	3	35
Bleu C			
S1	6	12	28
S2	5	14	31
S3	17	11	30
Rouge A			
S1	1	1	12
S2	4	0	17
S3	15	0	18
Rouge B			
S1	1	0	3
S2	5	0	10
S3	4	2	6
Rouge C			
S1	1	2	15
S2	0	2	21
S3	2	0	20

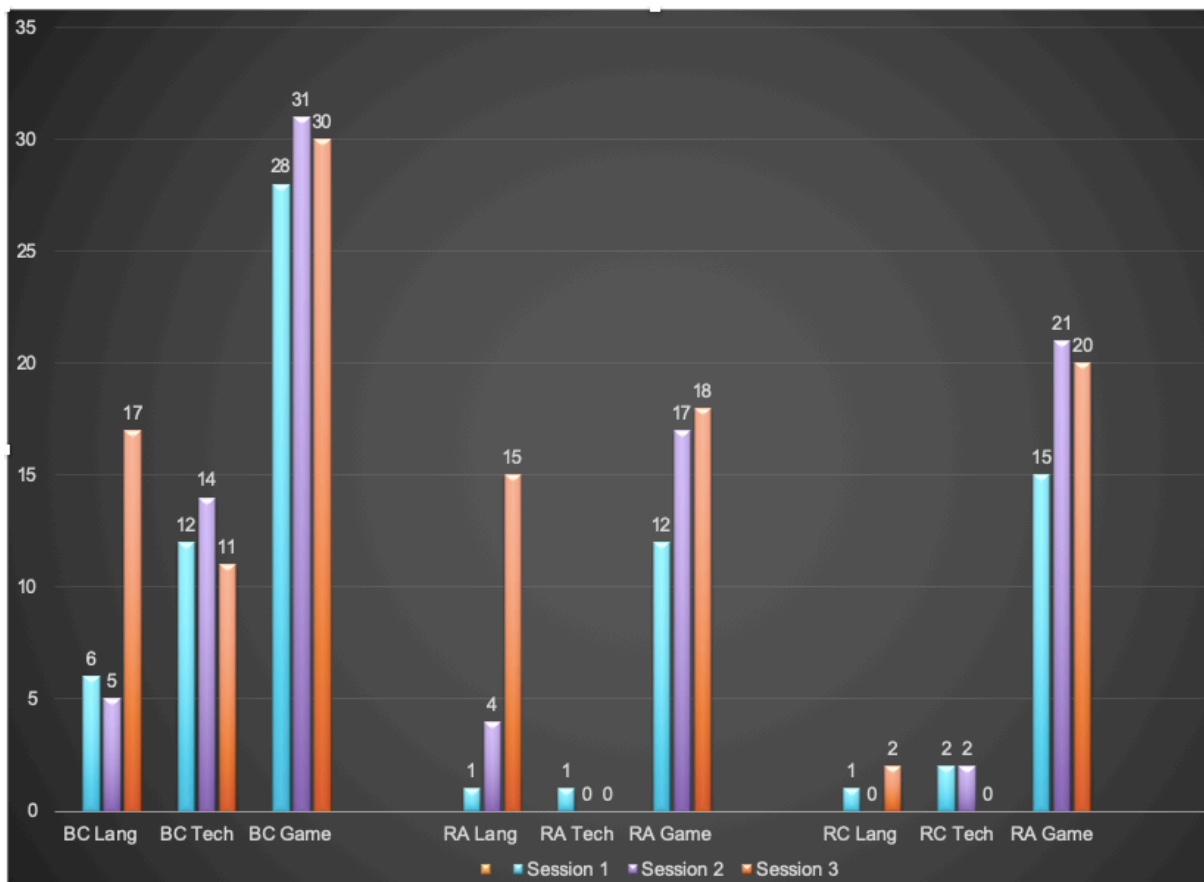
As seen in Table 21, two teams (Bleu A and Bleu B) did not have recordings of all three sessions, due to technical issues, human error, or the team dissolving. Also of note, is the fact that team Rouge B had one consistent student for all three sessions, but this participant had a different partner each time. Therefore, Bleu C, Rouge A and Rouge C were the teams with a recording of all three sessions, and in which the members of the teams stayed the most consistent.

Figure 8 illustrates these Fran 160 teams' frequency usage of each type of collaboration per session. During session 3, the Bleu C and Rouge A teams' instances of collaborating regarding the TL increased by over three times compared to the previous session. This significant increase in language collaboration was in relation to the increase in level of difficulty in *Explorez*. However, also relevant is that these teams made the effort and took the necessary time to understand the gaming content. Rouge A students employed an online dictionary 16 times, and Bleu C participants 10 times during gameplay. The dictionary was used to look up in-game vocabulary, as well as look up vocabulary players wanted to use when creating their Tweets. Rouge C in comparison only collaborated regarding language interactions three times in total. The Rouge C team did not use a dictionary at any time and chose instead to infer meaning when there was unknown vocabulary during gameplay or when inquiring from teammates "comment-dit on X" and if no other team member knew the answer, the students in this group instead chose to reword their response with known vocabulary.

Regarding collaboration and a technical aspect of the tools, Bleu C had approximately a dozen per session, while the other two teams had very few instances in total. Worth noting is that the number of instances does not necessarily indicate ease of use. Team Bleu C was the team with Participant F18P1 who had extensive gaming experience and commented "[w]e didn't really

encounter any bugs...we just followed the steps and it worked fine. It's pretty self-explanatory, it works the same as most gaming applications.” The high occurrence of collaborative technical instances for this team, in comparison to the other Fran 160 teams, represented the Bleu C students working together interacting with the game objects, navigating the interface, and using the Twitter recordings functionality. Video data showed that team Rouge C’s ease of use of the systems was on par to that of team Bleu C. However, team Rouge C had a participant (F18P27) who took a lead role during gameplay (this participant wore the GoPro for all 3 sessions and held the device most of the time), and although he navigated the systems with ease, at times he also silently read and then pushed through gaming content without sharing the information with his teammates.

Figure 9. Fran 160 teams’ collaborative episodes (type and frequency)



Collaborating regarding gameplay had the highest number of interactions for all teams. Bleu C averaged 29.7 times per session, Rouge A averaged 15.7 times per session, and Rouge C averaged 18.7 times per session. As detailed in section 2.7.4 *Gaming Research*, the gamified systems were designed to promote collaborative gameplay interactions. However, this was also dependent on the level of engagement of the team members, thus the number of collaborative interactions varied by team. Documenting the number of collaborative instances allowed for an overview of team interactions. However, video analysis details provided a more holistic view given that different player/learner types affected the collaborative interactions of the teams. For example, in the Fran 160 cohort, teams Bleu C and Rouge C appeared to be on two ends of the spectrum; with Bleu C an example of a team that collaborated very effectively, and Rouge C a team that was much less effective in their collaboration.

The Bleu C team were very engaged with each other, as well as the gaming content. The video data showed the iPhone often changing hands between team members as the students took turns reading game content, assisted each other with completing tasks, as well as discussing the content and next steps of gameplay. All three team members were involved in the discussion of what they wanted to post to Twitter before creating the post, and then for almost all recordings each student contributed, with each team member speaking on the recording. When there were pop-up questions this team read the question out loud and took the time to choose the answer together or at times debated which answer to choose when they were not all in agreement. Most interactions coded for Bleu C were several consecutive turns between speakers.

In sharp contrast to the previous team's high level of collaboration, overall team Rouge C had 59% fewer collaborative instances in comparison to team Bleu C. The student from Rouge C

that wore the GoPro for all three sessions held the device most of the time, and this team member (participant F18P27) read most of the game content out loud. There were also several instances of team members gathered around the device reading content silently. When walking between locations the participant holding the phone at times would read content silently and push through without sharing the information with his teammates. This was also the case for several of the pop-up questions. In contrast to Bleu C which had many lengthy interactions with several consecutive turns between speakers, more than half of Rouge C team's interactions were quite brief (~10s in duration). These were instances of a single turn between two students, such as a team member asking a question, and another teammate responding with a brief answer. This team did however show improvement in their collaborative interactions with each subsequent session, which will be addressed in section 4.3 *Participant Collaborative Learning*. The two teammates that rarely read out loud did not appear unengaged, but more so timid, and thus appeared to gain confidence, as well as speak more in the target language with each subsequent session.

Team Rouge A's level of engagement and collaborative exchanges fell between the other two teams. Overall, three team members appeared very positive and engaged with the whole process (further supported by two of these members responses to the questionnaire 2 and interview data), while the fourth student became frustrated at times, and expressed disliking posting tweets; despite often placing herself in the lead role for the team. This team's collaboration will be explored further in section 4.3 *Participant Collaborative Learning*.

The one recording of Bleu A showed the team members very engaged with each other and the gameplay content, similar to Bleu C. This was also the case for the Bleu B group during session 2 with *Explorez*, and these students were very intent on progressing as far as possible, intent on

“winning”. Bleu B collaborated 35 times regarding gameplay interactions in session 2, the highest frequency of such interactions for any Fran 160 team. Yet, it is also worth noting that this was at the expense of some of the tasks. On several occasions these students skipped posting to Twitter and instead as a team chose to progress to the next stage of gameplay without completing the requested task.

4.2.2 Fran 120 participants collaboration

In regards to the second cohort, Fran 120, as seen in Table 22 these teams collaborated regarding the target language between 2-27 times per session with a total of 134 interactions for all three sessions. This is an average of 10.3 times per team per session. The Fran 120 teams average of language interactions was almost double that of the Fran 160 teams (an increase of 94% from the Fran 160 average of 5.3 times per session). Fran 120 students’ interactions were very similar to those of the Fran 160 cohort; the Fran 120 participants collaborated with teammates, aiding each other with vocabulary, grammar, or pronunciation in the TL. This cohort also engaged with the pop-up vocabulary questions, with most participants using the opportunity to converse with their peers and choose the correct response.

Table 22. Collaboration type Fran 120

Teams	Collaboration type		
	Language	Tech	Gameplay
Vert A			
S1	22	2	23
S2	19	7	38
S3	27	10	40
Vert B			
S1	19	3	29
S2	4	0	22
S3	8	8	25
Vert C			
S2	11	6	27
S3	6	3	23
Bleu A			
S1	6	2	15
S2	3	15	18
S3	3	15	26
Bleu B			
S1	4	1	12
S2	2	1	21

Pertaining to collaboration and a technical aspect of the tools, Fran 120 participants interacted 1-15 times per session for a total of 73 interactions, an average of 5.6 times per team per session (representing a 51% increase of instances compared to Fran 160). Participants assisted their peers with navigating the user interface, interacting with gaming objects, and using the Twitter functionality for making voice recordings.

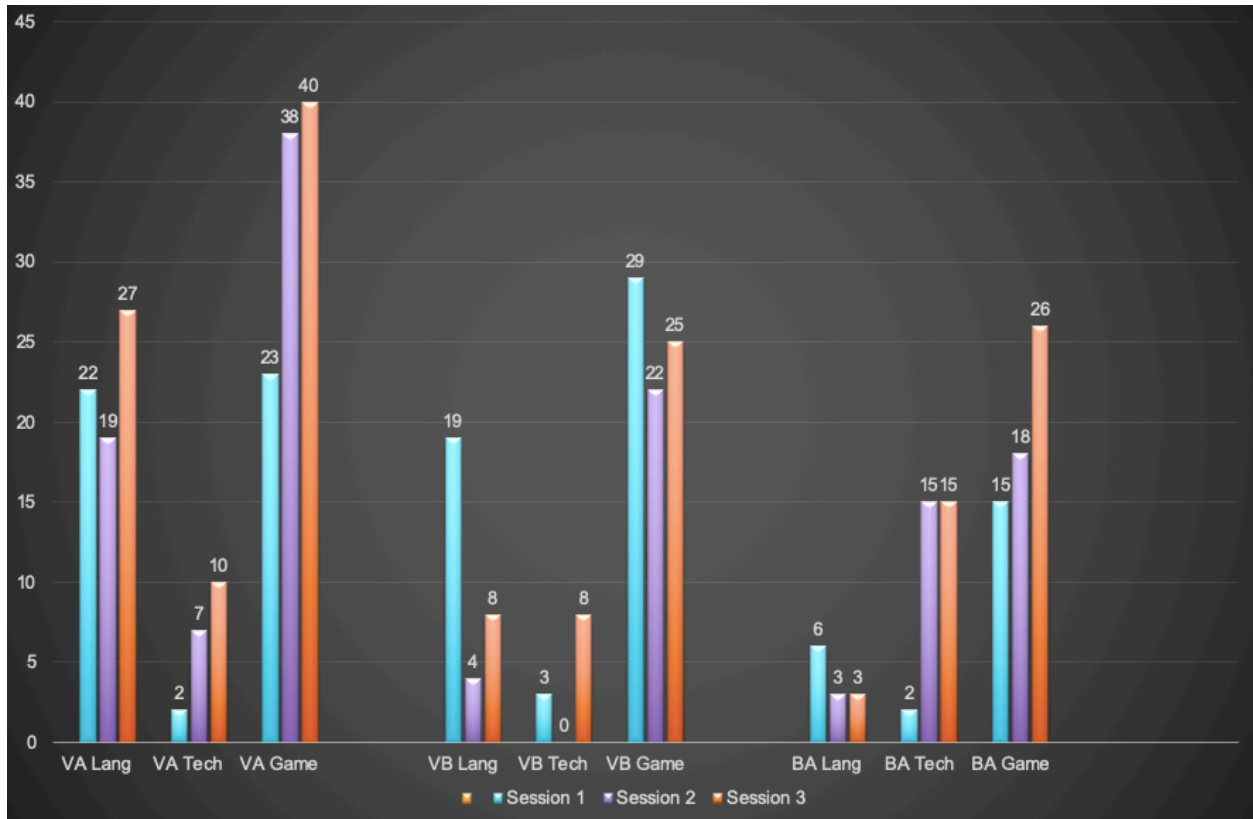
Regarding gameplay collaboration, Fran 120 students interacted 12-40 times per group per session for a total of 319 instances, which is an average of 24.5 times per team per session (a 26% increase of instances compared to Fran 160). The types of interactions observed were very similar to those of the previous cohort, such as participants worked together to understand gameplay

instructions, and made choices prompted by the system. Additionally, participants worked together to complete tasks, especially Twitter recordings. What differed with this group was that the students not only discussed the content, but many also practiced what they wanted to say before starting the Twitter recording, an additional step not taken by the Fran 160 teams. Furthermore, the Fran 120 cohort relied more heavily on using English to communicate (this will be discussed further in section 4.4 *Language Learners Group Interactions in the AR Gaming Environment*), in comparison to the Fran 160 group. This is not unexpected given that the Fran 120 students had a lower level of language competencies. Additionally, the Fran 120 students' lower language level likely played a role in this cohort's increased instances of collaboration; the students needed to work together to understand the content.

Additionally, as in the previous cohort, two teams (Vert C and Bleu B) did not have recordings of all three sessions⁸. Vert A, Vert B and Bleu A were the three Fran 120 teams with all three recordings. Figure 9 illustrates these teams' usage frequency of each type of collaboration per session.

⁸ One of the missing recordings was due to human error and the other to a team dissolving.

Figure 10. Fran 120 teams' collaborative episodes (type and frequency)



Illustrating two ends of a spectrum, Team Vert A had a high number of instances of language collaboration (an average of 22.7 interactions per session), while Bleu A team had very few (an average of 4 times per session). Additionally, the high instances of language interactions for teams Vert A and Vert B in session 1 (22 and 19) was due to these teams working together with the other teams during the end scene of *VdeUVic* to understand the narrative and choose from the prompted options. However, team Vert A continued to be very engaged and sustained their high number of collaborative language interactions for all three sessions.

Pertaining to team collaborative episodes regarding a technical aspect of the tools, Teams Vert A and Vert B had a different team member wear the GoPro each session, and therefore this individual also held the device. Bleu A had the same participant wear the GoPro for sessions 2 and

3, and she herself stated she was not tech savvy, and asked her teammates for assistance when needed (such as navigating the gameplay interface and tweeting). The different frequency of technical assistance was most often due to the comfort level the team member holding the device had with the technologies. Additionally, occurrences were dependant on a student's willingness to ask for assistance if needed and/or another student assisting on their own when noticing their teammate struggling.

Collaboration pertaining to gaming content had the highest number of interactions for every team, as in the previous cohort. Team Vert A collaborated an average of 33.7 times per session, team Vert B an average of 25.3 per session, and Bleu A collaborated an average of 19.7 times per session. Similar to the Bleu A team in the Fran 160 cohort, Team Vert was highly engaged and persistently collaborating to understand the gaming content, progress in gameplay, and complete the tasks. The Fran 120 cohort did not have a team where one student took the lead role for the team, as seen in Fran 160 teams Rouge A and Rouge C.

4.2.3 Fran 100 participants collaboration

Overall, the Fran 100 teams collaborated regarding the target language 4-14 times per team per session for a total of 63 interactions, an average of 7.9 per session (see Table 23). This average falls between the previous two cohorts. Teams Bleu A and Vert A had considerable amounts of assistance from the accompanying language experts. Bleu A asked vocabulary questions of the accompanying TA an average of 12.3 times per session, and Vert A asked such questions an average of 13 times per session. Therefore, these teams relied more on the accompanying language expert than each other. However, given that gameplay content was created for Fran 160 level, I

was already aware that the content was above the level of these French students. Therefore, in order to avoid impacting gameplay progression negatively, assisting Fran 100 students with vocabulary if they requested it had been discussed before playtesting. Interestingly Team Vert B only had one assist from the language expert for each of the two recorded session. The participant who wore the GoPro and held the device for session 1 was very adept in both gaming and technology. During session 1 this participant (S19P21) employed the in-game online dictionary 14 times when he or any other team member questioned a vocabulary word. During session 2, when a different student wore the GoPro, and a team member questioned a vocabulary word, participant S19P21 responded multiple times encouraging the use of the online dictionary (for example: “well let’s use the dictionary”; “there’s the dictionary in the game tab, I think we should use all resources available to us”; and “let’s look it up! I love learning new vocabulary!”). On camera this team accessed an online dictionary 17 times in session 2. This Fran 100 team had the highest occurrences of employing an online dictionary of any teams during gameplay of *Explorez*.

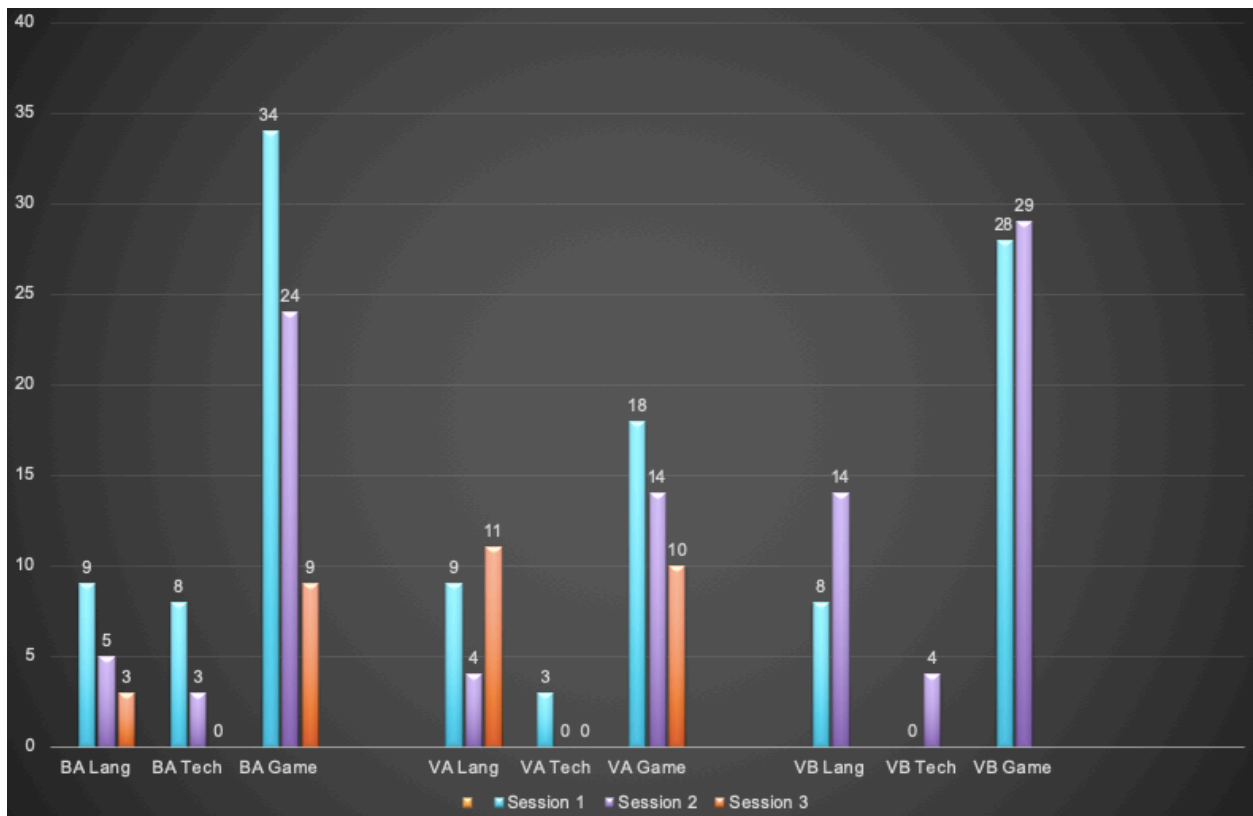
Table 23. Collaboration type Fran 100

Teams	Collaboration Type		
	Language	Tech	Gameplay
Bleu A			
S1	9	8	34
S2	5	3	24
S3	3	0	9
Vert A			
S1	9	3	18
S2	4	0	14
S3	11	0	10
Vert B			
S1	8	0	28
S2	14	4	29
S3	--	--	--

Collaborations pertaining to the technology occurred 0-8 times per team per session for total of 18 interactions, an average of 2.3 times per session. This cohort had the least number of instances assisting each other regarding a technical aspect of the tools of all three cohorts; not surprising given that these students were all well versed in technology, and most had gaming experience.

Gameplay collaboration occurred 9-34 times per team per session for total of 166 interactions, an average of 20.8 times per session. Frequency of gameplay collaboration remained fairly similar for all three cohorts, with a 15% or less difference between cohorts (increase of 9% compared to Fran 160 and a decrease of 15% compared to Fran120).

Figure 11. Fran 100 teams' collaborative episodes (type and frequency)



Contrary to the previous two cohorts who commenced with *VdeUvic* and then moved on to *Explorez* for the remaining two sessions, the eight Fran 100 participants played *Explorez* for the first two sessions during their language labs, and the third session was the entire Fran 100 class playing *VdeUvic* as a class activity. The Vert B team was dissolved in the third session due to absentee students and therefore did not have a recording. As seen in Figure 10, Fran 100 students had the least amount of collaborative gameplay interactions during the last session playing *VdeUvic*. In the limited time available I had made as many adjustments as possible to *VdeUvic* in order to simplify it for this cohort. However, without a team member with a strong language base *VdeUvic* was too difficult for this level. However, in regards to *Explorez*, worth noting is that the Fran 100 teams progressed as far as the Fran 120 teams. The Fran 100 cohort's strong technical knowledge assisted the students greatly despite their struggle with the higher level of French language gaming content.

Although this analysis documents the frequency of the collaborative interactions, it does not consider the duration of each instance. Therefore, for a more in-depth examination of CL, Volet et al.'s (2009) framework was adapted for the next research question.

4.3 Participants collaborative learning

This research also sought a deeper examination of collaborative learning and thus a means of capturing this through video data analysis was employed through the adaptation of Volet et al.'s (2009) CL framework. This analysis examines the ways L2 learners socially regulate and process content during gameplay (RQ4). Drawing on Volet et al.'s framework, coding was performed at the episodic level identifying low-level individual regulation, low-level co-regulation, high-level

individual regulation, and high-level co-regulation. However, unlike Volet et al.'s study, which coded videos solely on verbal interactions, the nature of the gameplay activities in the present research resulted in many player interactions that were not verbal; especially when students were interacting with the tool. The added value of video footage offered the potential to also code non-verbal instances of both low and high-level content processing. For example, when students were using online dictionaries or creating a tweet. Additionally, given that gameplay is not stationary, students were physically moving to different locations interacting with their surrounding environment, each other, the tools, or walking in silence. Thus, the categories for "other" emerged as recurring themes were marked within the data (Brinkman & Kvale, 2015). This evolving analysis revealed the following empirically derived codes for the breakdown of content other than *processing gameplay*:

Other breakdown

- Off task – small talk in English
- Expert help – question posed to a TA, prof, librarian
- Silently reading game content
- Silent walking
- Other gameplay
 - small talk in French
 - not silent but also not enough content to code (less 10s bursts)
 - interacting with gaming interface but no dialogue to code
 - Time posting and tagging tweet after created
 - Watching game content videos

The data coding and analysis employing Volet et al.'s framework was restricted to data set 1 and 2 (Fran 160 and Fran 120); because these cohorts had either no accompanying language expert or limited interference from the accompanying researcher/TA. Additionally, to remain as consistent as possible for the close analysis of CL, only the teams that had minimal or no changes for team members, as well as all three sessions recorded were included (several team sessions were

not recorded either due to human error or technical issues, and student absentees affected team member consistency). This resulted in three of six teams from Fran 160, and three of five teams from Fran 120 selected for this phase of video coding and analysis.

In order to employ the adapted framework and explore collaborative learning by means of tracking the emergence of high-level co-regulation during gameplay, the data was examined by three means: the focus of interactions during gameplay; patterns regarding the emergence of high-level co-regulation; and contributing factors to sustained high-level co-regulation.

4.3.1 Students focus of interactions during gameplay

As in Volet et al.'s study the first step to exploring this framework is examining the focus of interactions across the groups and sessions. Lines one to seven in Table 24 show the breakdown of Fran 160 teams *focus of interactions*. These teams observable focus on *content processing during gameplay* was 56.2% to 85.7% of the time. *Other gameplay* constituted 1% to 23.9% of the time. Additionally, several of the *other gameplay* elements could be argued to also include *content processing* for second language learners, such as conversing in the target language, watching French videos with the intent to understand the content, and interacting with the L2 gaming interface. When combining the two categories, *gameplay processing* and *other gameplay*, the potential for *content processing* increases from an average of 67% to 83% of the time per team per session.

Given that the nature of the activity was gameplay, and that the overarching goal of the learning activity was to explore the campus in the TL, the amount of time students spent in small talk in English and thus *off task* is relevant. Fran 160 teams spent 0-14.9% of the time *off task*, an

average of 6% of the gameplay time per team per session. Additionally, choosing to *silently read* gaming content also hinders opportunities for the students to collaboratively work through and comprehend gaming content. Fran 160 teams *read content silently* 0% to 7.5% of the time with an average of 3% per team per session. Therefore, overall, the participants spent the vast majority of time on task, with an average of 67% to potentially 83% of the time spent processing content.

In regards to the next section, the close analysis of content processing in *breakdown by dimension* the focus remained solely on the observable *gameplay processing* percentages, and was examined by each session in order to explore any variances between sessions and groups. The first three columns in Table 24 displaying Session 1 of gameplay show *high-level processing* constituted 13.1% to 28.7% of the time, while *low-level content processing* constituted 45.3% to 57% of the total time. The substantially higher occurrence of *low-level content processing* was not unexpected given the nature of the activity. Additionally, research highlights the importance of low-level content processing in L2 learning (Nassaji, 2014). However, what is noteworthy is that the Bleu C team's *high-level content processing* was close to double that of the other two teams who had similar amounts of high-level content processing. As mentioned previously (section 4.2.1 *Fran 160 Participant collaboration*) Bleu C team members were highly engaged with each other, and the gaming content. Thus, further supporting team dynamics and student engagement with the content impacts the potential for learning.

In regards to the dimension of social regulation, participant *co-regulation* (48% to 56.9%) engagement was substantially higher than *individual regulation* (11.4% to 28.8%) across all groups. Further divergence between groups and patterns emerged in the *full breakdown*. While the engagement in *high-level regulation* between co and individual was about on par for Rouge A, and

Table 24. Fran 160 interactions

	Session 1 (% time)			Session 2 (% time)			Session 3 (% time)		
	Bleu C	Rouge A	Rouge C	Bleu C	Rouge A	Rouge C	Bleu C	Rouge A	Rouge C
<i>Focus of interactions</i>									
Processing gameplay	85.7	60.2	59.8	72	60.4	59.3	65.9	78.7	56.2
Other breakdown									
Off task	11.1	7.1	14.9	0.7	0.7	1.4	7.8	0	11.4
Other gameplay	5.5	13.2	1	16.5	23.5	18.8	23.9	19.9	17.4
Expert help	1.2	10	9.7	5	9.8	4.1	2.7	0	0
Silently reading game content	0	7.5	6.3	0.8	0	6.2	0.4	0.6	3.2
Silent walking	5.2	4.2	8.3	9.8	2.8	16.9	4.7	9.4	19.9
					7.4 ⁹				
<i>Breakdown by dimension</i>									
Content processing									
Total high-level	28.7	13.1	14.5	29.9	15.9	18.4	21.4	37	23.5
Total low-level	57	47.1	45.3	42.1	44.5	40.9	44.5	41.7	32.7
Social Regulation									
Total individual regulation	28.8	11.4	11.8	11.5	24.2	26.4	20.6	23.3	20.5
Total co-regulation	56.9	48.8	48	60.5	36.2	32.9	45.3	55.4	35.7
<i>Full breakdown</i>									
High-level co-regulation	16.1	6.8	3.8	23.4	9.6	8.2	14.2	27	9.9
High-level individual regulation	12.6	6.3	10.7	6.5	6.3	10.2	7.2	10	13.6
Low-level co-regulation	40.8	42	44.2	37.1	26.6	24.7	31.1	28.4	25.8
Low-level individual regulation	16.2	5.1	1.1	5	17.9	16.2	13.4	13.3	6.9

Note. Fran 160 cohort’s focus and percentage of time on interactions by three groups in the three sessions

⁹ No recording due to the fact I was assisting other students

also similar for Bleu C, Rouge C had substantially less *high-level co-regulation* than *high-level individual regulation*.

Volet et al. expected that by the second meeting students would have made considerable progress regarding their knowledge of the case study, and thus the second meeting would in result allow for increased opportunities of collaborative learning. Volet et al.'s results partially supported this expectation. Given the nature of gameplay in the present research, and the additional fact that each session held new gaming content (and in the case of the two sessions with *Explorez*, the gaming content was designed to increase in difficulty as the learners progressed), it remained to be seen if within this learning context, subsequent sessions would afford greater opportunities for collaborative learning.

The complexity of gameplay in *Explorez* (Sessions 2 and 3), in comparison to the first session with *VdeUVic* resulted in a substantially higher percentage of time spent on *other gameplay*. For example, time spent on tasks such as physically finding the correct book in the library (Quest Level 1) and watching the French movie trailers (Quest Level 2). For team Bleu C this represented a reduction in the observable *processing gameplay*, while teams Rouge A and Rouge C maintained the same percentage of time in this category. All three groups had substantially less time *off task* in the second session. Additionally, in Session 2 all three teams showed a slight increase in total *high-level content processing*, and a decrease in *low-level content processing*. In regards to social regulation, Bleu C team increased in *co-regulation*, while the other two teams' total *co-regulation* somewhat decreased. However, in the *full breakdown*, all three teams experienced an increase engaging in *high-level co-regulation*. This may have been due to a combination of gameplay design as well as student team dynamics.

In session 3, both Rouge A and Rouge C teams once again engaged in an increased amount of *high-level content processing*. Rouge A had a substantial increase in total high-level, which over doubled from the previous session (from 15.9% to 37%). For the first time Bleu C team saw a decrease in *high-level content processing*, and had the lowest percentage of the three teams, instead of a substantial higher amount than other teams as seen in the previous sessions. Yet Bleu C's lowest percentage in S3 (21.4%) was still higher than the two other teams' percentages in S1 and S2. Worth noting is that Session 3 took place on the last day of class of the semester. At least one member from all three teams commented on this during gameplay, and team Bleu C participant Dave (F18P1) states "it's so hard to speak in French today! My brain is elsewhere, I can't believe the semester is almost over!" Additionally, *off task* percentages also increased for two of the three teams. In the full breakdown the Bleu C team decreased in *high-level co-regulation*, the Rouge C team increased slightly, and the Rouge A team engagement in *high-level co-regulation* almost tripled from S2 (from 9.6% to 27%).

As seen in Table 25, the Fran 120 cohort's focus of interactions breakdown shows these teams observable *gameplay content processing* was 43.4% to 85.1% of the time. Similar to Fran 160 groups, *other gameplay* also varied greatly amongst the Fran 120 teams and constituted 2.4% to 48.7% of the time. For these students, in addition to conversing in the target language, watching French videos with the intent to understand the content, and interacting with the L2 gaming interface, even tagging and posting a tweet for those not yet versed with the technology was also acquiring new knowledge, and thus another element of *content processing*. Parallel to the Fran 160 cohort, the combination of both *gameplay processing* and *other gameplay* increased the overall

potential content processing time of Fran 120 teams, from an average of 60% to 79% of the time per team per session.

Additionally, the Fran 120 teams spent 0.8% to 12.5% of the gameplay time *off task*, an average of 6% of the time per team per session (and the same amount as the Fran 160 group). However, Fran 120 students chose to *silently read game content* substantially more than the previous group, from 0% to 22% of the time, an average of 7% of the time per team per session (over double that of Fran 160 at 3%). Despite this, overall Fran120 participants also spent the vast majority of time on task, with an average of 60% to potentially 79% of the time spent *processing content*.

Regarding the close analysis of content processing in *breakdown by dimension*, the first three columns in Table 27 show *high-level processing* constituted 6.1% to 31.1% of the time, while *low-level content processing* comprised 34.6% to 50.2% of the total time during Session 1. The substantially higher occurrence of *low-level content processing* in two of the teams was not unexpected. However, noteworthy in this cohort is that team Vert A had very similar levels of both *high* and *low level-content processing*. As mentioned previously (section 4.2.2 *Fran 120 Participant collaboration*) Vert A team members were the students in this cohort highly engaged with each other and the gaming content.

In the *breakdown by dimension* of the social regulation Fran 120 participants spread was more pronounced than that of the Fran 160 students. Fran 120 participants *co-regulation* (47.5% to 73.3%) engagement was pointedly higher than *individual regulation* (0%-1.3%) across all groups. Given the minimal or complete lack of *individual regulation* for these teams the *full breakdown* provided minimal further information. However, this further highlighted that teams

Table 25. Fran 120 interactions

	Session 1 (% time)			Session 2 (% time)			Session 3 (% time)			
	Vert A	Vert B	Bleu A	Vert A	Vert B	Bleu A	Vert A	Vert B	Bleu A	
<i>Focus of interactions</i>										
Processing gameplay	65.7	74.6	47.5	64.4	43.8	49	85.1	59.8	43.4	
<i>Other breakdown</i>										
Off task	12.5	0.8	4	2.7	2.3	0.6	10.4	8.5	10.6	
Other gameplay	20.2	17.9	15.1	12.5	48.7	23.2	2.4	21.4	18.9	
Expert help	1.8	6.1	3.6	4.2	1.7	2.2	2.7	9.6	1.5	
Silently reading game content	0	0.5	22	0.3	7.8	19.6	0	0.7	11.6	
Silent walking	0.4	2.3	8.3	1.2	6.3	6.3	0	2	10.8	
				16.2 ¹⁰						
<i>Breakdown by dimension</i>										
Content processing										
Total high-level	31.1	24.4	6.1	13.6	5.1	9.6	19.8	8.1	3.6	
Total low-level	34.6	50.2	41.4	50.8	38.7	39.4	65.3	51.7	39.8	
Social Regulation										
Total individual regulation	0.3	1.3	0	6.7	9	0	5.6	4.9	0	
Total co-regulation	65.4	73.3	47.5	57.7	34.8	49	79.5	54.9	43.4	
<i>Full breakdown</i>										
High-level co-regulation	30.8	24.4	6.1	11.8	3.1	9.6	14.9	8.1	3.6	
High-level individual regulation	0.3	0	0	1.8	2	0	4.9	0	0	
Low-level co-regulation	34.6	48.9	41.4	45.9	31.7	39.4	64.6	46.8	39.8	
Low-level individual regulation	0	1.3	0	4.9	7	0	0.7	4.9	0	

Note. Fran 120 cohort's focus and percentage of time on interactions by three groups in the three sessions

¹⁰ Time lost due to a technical glitch and issues with the GoPro

Vert A and Vert B had substantially higher levels of *high-level co-regulation* than team Bleu A. This was due to these two teams engaging with each other during the last scene of *VdeUVic*. The intent was for all three teams to work together during the final gameplay scene, but due to time constraints when Bleu A had not yet arrived at the Quad, and the allotted time was waning, the other two teams moved on together. When the Bleu A team arrived, this team completed this section on their own by employing the gameplay hack.

During Session 2 with *Explorez*, two of the three teams had an increase in *other gameplay*, as seen in the Fran 160 group (this was not the case for Team Vert A, however this team lost 16.2% of the time due to a technical glitch and issues with the GoPro). Overall, this cohort also spent less time *off task* during Session 2, once again, paralleling the Fran 160 cohort. The only team to see an increase in *high-level content processing* however was Bleu A, the team that played *VdeUVic* without other teams in the end scene. Teams Vert A and Vert B engaged in small amounts of *high-level individual regulation* when creating a Tweet.

In Session 3 *off task* increased across all groups (from an average of 1.9% of the time in S2, to an average of 9.8% of the time in S3), similar to the Fran 160 cohort, this session took place near the very end of term. Once again in the video data students are heard talking about end of the semester. *Processing gameplay* increased for both Vert A and Vert B, and these teams' engagement in both *high-level* and *low-level content processing* also increased. Additionally, both teams' total *co-regulation* increased, while *individual regulation* decreased. In the *full breakdown* Vert A and Vert B teams' engagement with *high-level co-regulation* increased from the previous session. Regarding the Bleu A team, *individual regulation* was non-existent for all three sessions, and this team's engagement with *high-level co-regulation* decreased in S3.

4.3.2 Emergence of high-level co-regulation

Similar to Volet et al.'s study, an additional potential benefit of employing the framework was to investigate if any relevant patterns regarding the emergence of high-level co-regulation could be identified. Findings showed that the emergence of high-level co-regulatory episodes were most often initiated by a question, either direct or implied, or an explanatory statement or summary. In the present study all recorded teams from both cohorts showed these instances, following are some examples: “Je ne comprends pas...” (implied question, participant Sadie [F18P16] Fran 160); “I thought we had to record something...” (implied question, participant Grace [S19P13] Fran 120); “Qu’est-ce que vous savez de les Misérables?” (direct question participant Julie [F18P14] Fran 160); “Qu’est-ce que nous... parlons de?” (direct question participant Grace [S19P13] Fran 120); “Ok, on doit maintenant commander un repas en français...” (explanatory statement Dave participant [F18P1] Fran 160); “We could say like nous appelons and say all four of our names, and then ensemble nous appelons then our team name” (explanatory statement participant Kylie [S19P4] Fran 120). Worth noting is that within the gamified L2 context, the intentional design elements of task completion prompted the majority of the high-level co-regulation episodes. Students responding to gaming prompts, open ended questions, as well as the need to create a twitter post resulted in the students discussing how to proceed, and what they should do, and hence the emergence of high-level co-regulation content processing.

4.3.3 Contributing factors to sustained high-level co-regulation

The final step of the adapted framework was exploring potential contributing factors to sustained high-level co-regulation in group interactions during gameplay. Volet et al.'s study identified four

possible factors to a group sustaining high-level co-regulation: 1) asking questions, 2) tentativeness of explanations, 3) background knowledge, and 4) shared positive emotions. These factors were also present in the following analysis of gameplay, although somewhat modified given the dissimilar learning context.

In excerpt 5 (see appendix E) all three students in the Fran 160 the Rouge A team are gathered around the mobile device while creating a tweet in response to the task of informing the celebrity what services are available at the university SUB. Participant “Julie” (participant F18P14) took the initiative to type the tweet and used her device to do so. Most gaming tweets were audio or video recordings, but students were informed the choice was theirs. “Mary” (participant F18P19) held the device in use for gameplay, and “Claire” (participant F18P29) used her device to look up vocabulary during the excerpt. This multiple use of devices contributed to the division of tasks and allowed all three students to be more actively involved compared to doing all tasks on one device. Although Julie was the one typing the tweet, all three participants contributed to the content creation of the tweet and worked together regarding spelling and vocabulary.

Although Volet et al.’s study highlighted the significance of high-level *questions* contributing to high-level co-regulation (such as students responding to “how” questions), the content of L2 gameplay did not lend itself to frequent questions of this nature. In the gameplay context, *high-level open-ended questions* (either proposed by the gaming content specifically or the students themselves) were likely to instigate and potentially sustain high-level co-regulation. Nevertheless, question-asking contributed to sustaining group engagement in high-level co-regulation during gameplay. In excerpt 5 the students collaborative learning is supported by their

negotiation of meaning including requests for help and comprehension checks. As seen in Excerpt 5 *question* asking was quite dominant throughout, with many requests for help (lines 5,8,14,16,18,28,32,47,49,55,63) pertaining to vocabulary, spelling, grammar, or content. For example: line 5 pertains to vocabulary as Julie asks “est-ce que c’est un mot? (is that a word?); line 16 concerns spelling as Julie sounds out the word as she types it, then asks “comme ça?” (like this?), and shows her teammates the screen; line 28 begins a discussion on the correct preposition for translating *at* for a masculine noun (grammar); and line 47 concerns content as Julie reads the beginning of the tweet then asks her teammates “quoi d’autre?” (what else?). Additionally, three questions entailed comprehension checks as seen in lines 34,35 and 73. For example, in line 35 after the speaker changes several times discussing the translation of *at*, Mary clarifies she is understanding correctly and asks “...or like what are you trying to say?”. As the students discuss and create the tweet content they illustrated high-level content processing, further supported by reasoning, building on each other’s ideas, requests for help and comprehension checks.

A second factor Volet et al. identified in the possible sustainment of high-level co-regulation was a *tentativeness of explanations*. The authors elaborated specifying that students sharing content knowledge with some uncertainty or lacking assertiveness possibly encouraged the other group members to also contribute and open/expand the dialogue further. This concept of *tentativeness* is seen throughout Excerpt 5 via the multiple requests for help, offering suggestions on the form of indirect questions, and also when the students are giving each other corrective feedback. For example, lines 30 and 33 when Mary is offering the correct translation of the preposition *at* to her teammates, she explains then includes “je pense” (I think). This *tentativeness* is also apparent in the students’ vocal tones, facial expressions, and body language in the video

recording. Claire's content suggestions (lines 48 and 56) are put forth as indirect questions and her tone and body language further support a *tentativeness*. As Volet et al. highlight this tentativeness is paralleled in educational psychology literature as *openness* and *non-defensiveness*. Vauras et al. (2003) state that openness is a significant factor in successful peer collaboration. When defining *openness* in peer group work, Vauras et al. elaborate: "[t]he partner has to be ready to "confess" and communicate her own lack of comprehension, to ask for help if needed, to give help in a friendly but adept manner, to be ready to listen and to take into account the partner's opinions, and to resolve disagreements without a sense of personal threat" (p.34). Therefore, the group dynamics must also allow for peer assistance, and the students themselves be open and willing to give and accept assistance. Throughout excerpt 5 the student's instances of tentativeness and the team's group dynamics, as well as individual demeanor were describable as open and non-defensive. Such tentativeness also assists in facilitating negotiation, given that "negotiation only occurs if there is space for it" (Vauras et al., 2003, p. 34). This supports that students' *tentativeness* and openness throughout gameplay, and not only in the excerpt above, assisted in sustaining their high-level co-regulation.

The third factor Volet et al. identified to sustaining high-level co-regulation was student's *background knowledge*. Volet et al. argue that "[t]here is evidence that distributed task-relevant knowledge increases high-level contributions to constructing knowledge in student work groups" (p.140). This mirrors the sociocultural perspective within the field of CALL, which focuses on the social nature of language learning and highlights learner interactions as a primary learning force. Additionally, it parallels the concept of scaffolding, which draws on Vygotsky's ZDP (1978), and is further adapted for language learning to define collaborative peer L2 learning, regardless of the

skill levels of the learners (Lantolf & Thorne, 2006). The learners take the roles of experts and novices and assist each other by means of scaffolding through peer interactions (Ohta, 2000). Thus, a learner is able to accomplish more via collaboration with peers, than what they could accomplish individually. In excerpt 5, this is supported by Mary's previous knowledge of the correct translation of *at* given that the noun is masculine. Julie asks her teammates about the translation of the preposition *at* (line 28) asking "à le?" and Mary responds with no, *à le* is *au*. After Claire asks if the SUB is masculine or feminine Mary attempts again, trying to explain in her own words that *à le* is *au*. Lines 28-44 are the three student's interactions concerning this translation with Mary reiterating numerous times (although as mentioned previously with at times tentativeness), until all three concur with the translation *au* and Julie types *au Munchie Bar* to complete the sentence. Throughout excerpt 5 the students effectively collaborate to create the tweet employing requests for help, comprehension checks, and corrective feedback.

The fourth factor identified by Volet et al. for sustaining high-level co-regulation was *shared positive emotions*. The multiple occasions of laughter throughout excerpt 5 support *positive shared emotions* amongst the team members. Laughter is brought on when Julie adds the suffix *ment* to the English word *obvious*, by the pronunciation of *kareoké*, and later on the misstated *cliquer*. The longest episode occurred when the participants were discussing the tweet containing the information that students can sing karaoke and drink lots of beer at the pub. Overall their demeaners appear playful, open and non-defensive. Additionally, despite the humour and laughter, the students stay on task in the creation of the tweet. Laughter is believed to serve as an instrument to build social cohesion (Robinson & Smith-Lovin 2001). Moreover, positive emotions can result in increased commitment to the group (Lawler & Yoon, 1993). Research also supports that

laughter can be a stress reliever, and function to reduce tension (Robinson and Smith-Lovin 2001). Lines 19 and 21 were coded as *chuckles* because it was a quieter laugh, and Claire appears to more-so be chuckling to herself and the other team members do not join in. Claire's reaction appears to be in response to her vocalized embarrassment for using google translate. Worth noting is that Mary responds with positive emotions, and reassuringly responds that Claire shouldn't be embarrassed, and also suggests Word Reference as another resource, stating both resources work [lines 23-27]. Similar to Volet et al.'s study, the *positive emotions* and laughter in excerpt 5 appear to potentially play a role in the student's engagement in sustaining the high-level knowledge construction.

4.4 L2 learners group interactions in the AR gaming environment

This research also examined what this type of experience means specifically for language learning. In this vein, additional coding of the video data contained markers to document how language learners interacted as a group in the AR environment (RQ5). The duration of gameplay was noted to document set-up time, and game gameplay progress to allow a comparison between teams and cohorts (adapted from Perry's 2015 study). Mobile systems require students to navigate between physical locations, and potential resulting lapses of silence were noted in Perry's (2015) study. To address this issue, additional game elements were integrated during the development of the gamified L2 environments. The players spoken language use was coded and examined to determine the percentage of French versus English spoken during the task (created for this study). Informed by Nasir et al.'s study (2015), the number of times two or more team members laughed together was coded as a means to analyze group cohesion, which can impact collaboration.

4.4.1 Duration on gameplay

The Fran 160 class sessions were 80¹¹ minutes each, and duration of gameplay for the Fran 160 teams varied from 40 minutes to 61 minutes during the three sessions. In addition to removing set-up time, in order to document actual gameplay time, I also removed the time students spent at the end of each session walking back to the meet up area. This cohort easily finished *VdeUvic* in under an hour (40-48 minutes playtime). Set up time was the longest during this first session (~30 minutes), with several students requiring assistance creating and logging into their accounts; a couple students had not yet downloaded the app, several students didn't recall their login information, and a few devices crashed when loading the game. I also described the activity and advised students to speak with their designated TA if they encountered issues during gameplay. The allotted 80-minute class time was enough to deal with any pre-game issues encountered, answer questions, and still enough time for the students to play *VdeUvic*. However, facilitating the necessary organizational components for 40+ students was quite challenging during this first session. In retrospect, one more in-class visit beforehand, to verify the students had comprehended and followed the instructions sent online, and knew who their teammates were, would have made this first session more manageable. The students became more comfortable with the technology with each subsequent session, and I also learned how best to proceed (such as starting the GoPro cameras recording before handing them out to the students, and creating a hack for students to

¹¹ Although the Fran 160 cohort's allotted class time was 80 minutes (20 minutes longer than Fran 120 cohort's allotted 60 minutes), the difference in set up time between the two groups resulted in similar gameplay time. Fran 160's much longer 15-30 minutes set up resulted in 50-65 minutes of available gameplay time, and Fran 120's 5-10 minutes set up resulted in 50-55 minutes of available gameplay time. Actual documented gameplay time of the Fran 160 teams was 40-61 minutes, and 43-54 minutes for the Fran 120 teams.

verify in-class how to use the AR triggers). By session 3 the set-up process was fairly smooth and less time consuming (~15 minutes).

Additionally, the data from the gaming platform (quests completed, badges collected) was categorized and organized by team. Most Fran 160 teams completed Level 1 of *Explorez* during session 2 (the first session of *Explorez*), except one team that encountered a technical error resulting in a gaming loop. This cohort completed 3 to 6 Quests during S2, an average of 4.4 Quests per team. During session 3, the teams complete 2 to 4 Quests, an average of 3.3 Quests per team. The lower number of Quest completions was not unanticipated given that the Quests become more complex in levels 2 and 3. No teams completed all 12 Quests, nor did any team complete the game (game completion is possible by completing two of the four Quests at Level 3, see Figure 5 in Methodology). However, 5 of the 7 teams playing during S3 finished on a Level 3 Quest of *Explorez*, therefore close to the shorter game competition option, with only one or two Quests left to complete. Without the technical difficulties encountered, this level of learner potentially could have completed the shorter version of the game in two sessions of 80 minutes each, dependant on their level of engagement with the content at Level 3. Especially those teams with a member versed in gaming and technology (as mentioned in section 4.1 *Player experience details*) as these students did not have the additional learning curve of technical aspects and gaming comprehension. However, in order to complete all 12 Quests, it would appear that three sessions of gameplay specifically for *Explorez* would have been ideal for this cohort.

Substantially less time was spent on set-up time for the Fran 120 students, less than 10 minutes for the first session and 5 minutes for sessions 2 and 3. The Fran 120 sessions were 50-60 minutes each (120 minutes divided in two, with half the students participating during the first half,

then the rest of the students participating during the remaining time). Gameplay duration for the Fran 120 teams varied from 43 minutes to 54 minutes over the three sessions (again in addition to set-up time, the time students spent walking back to class was removed to correctly document gameplay time). The set-up process for these teams was streamlined, and the necessary preparatory logistics of identifying and finding team members, creating accounts and logging in were facilitated for these students (see section 3.4.2 *Data set 2 – Fran 120 Spring 2019*). This was to save time, given the shorter playtime from the previous cohort. Additionally, instead of demonstrating the ARIS interface use in class (as was done for the previous cohort), tutorial videos for both the ARIS interface and Twitter use were supplied in-game. These in-game tutorials appeared to facilitate gameplay using the ARIS platform and Twitter. Though these team members often assisted each other with the use of Twitter, which is not surprising given that many of the students had never before used the microblogging service. As seen with the Fran 160 cohort, the Fran 120 teams also became more comfortable with the technologies in subsequent sessions.

Despite the streamlined set up, the allotted 50 minutes was not sufficient time for most of the Fran 120 teams during session 1, and they may have benefited from more time in order to better understand the end scene of *VdeUVic*. However, even with the vocabulary sheet, *VdeUVic* contained too much unknown vocabulary for these lower-level students, and only the teams which had a stronger student who assisted comprehension for the others as they progressed, truly understood the storyline (this was the case for 120 teams Vert A and B). This game would require further editing in the end scene to be suitable for lower-level French students.

Regarding gameplay progress in *Explorez*, the Fran 120 teams completed three to five quests during their first session with *Explorez* (S2 of playtesting), an average of 4.2 Quests per

team. This is only slightly lower than the Fran 160 cohort's average of 4.4 Quests per team. During session 3 the Fran 120 teams completed 1-4 Quests with an average of 2.75 Quests per team. Most of the Fran 120 students required more time to read through and comprehend the gaming content once Level 2 of gameplay was reached. Two of the four Fran 120 teams did however start Level 3 Quests in S3. This cohort of learners would also require a third session for possible game completion. Although the higher-level quests were definitely challenging for these students, most teams comprehended gameplay content, with a heavy reliance on asking each other questions and working together to understand what was required.

4.4.2 Time on and off task

As seen in Table 26 column 3, Fran 160 teams remained on task an average of 93% during S1, an average of 99% during S2, and an average of 94% during S3. Similarly, the Fran 120 teams remained on task an average of 96% during S1, an average of 99% during S2, and an average of 91% during S3 (see column 3, Table 27). Overall participants from both cohorts spent the vast majority of time *on task*, engaged with the gaming content and/or exploring their campus in the target language.

Table 26. Fran 160 L2 learners group interactions

Bleu A	# of Tweets	% on task	% of French	# of lapses of silence	Total in seconds	Dictionary	Laughter
S2	7	100	77	5	93	0	36
Bleu B							
S1	6	96.3	87	4	81	0	35
S2	6	99.6	89	4	75	1	27
Bleu C							
S1	13	88.9	41	7	151	5	42
S2	8	99.3	90	14	364	3	34
S3	9	92.2	77	7	156	2	38
Rouge A							
S1	3	92.9	27	6	112	0	25
S2	10	99.3	87	2	98	3	45
S3	8	100	93	9	325	13	39
Rouge B							
S1	1	100	87	7	146	0	2
S2	6	100	98	4	53	1	27
S3	5	96.6	92	17	742	0	15
Rouge C							
S1	7	85.1	14	15	237	0	25
S2	14	98.6	30	13	571	0	26
S3	21	88.6	29	22	685	0	16

Note. Fran 160 coding pertaining to how language learners interact as a group in the AR environment

Table 27. Fran 120 L2 learners group interactions

Vert A	# of tweets	% on task	% of French	# of lapses of silence	Total in Seconds	Dictionary	Laughter
S1	2	87.5	48	1	12	2	51
S2	8	97.3	42	1	35	7	43
S3	8	89.6	43	0	0	8	47
Vert B							
S1	0	99.2	61	1	72	7	37
S2	3	97.7	50	8	196	0	29
S3	3	91.5	63	5	61	0	49
Vert C							
S2	5	99.4	24	9	210	1	28
S3	4	94.4	45	4	84	2	27
Bleu A							
S1	1	96	6	9	214	3	30
S2	5	99.4	24	8	170	0	33
S3	2	89.4	12	7	337	0	19
Bleu B							
S1	0	100	88	5	158	5	12
S2	4	100	71	13	389	0	24

Note. Fran 120 coding pertaining to how language learners interact as a group in the AR environment

4.4.3 Lapses in silence

As mentioned previously in section 3.5.4 *Analysis of student gameplay video data for learning context*, researchers of AR place-based L2 games have noted the issue of some student teams' large lapses of silence during gameplay while walking from one location to another (Perry, 2015; J. Sykes, personal communication, June 25, 2018). Therefore, this was considered during the current iteration of game development for *Explorez* by incorporating strategically placed hidden elements on the map (triggered by location) or timed elements (triggered by amount of time since last encountered game element). Natural lapses in conversation are also normal, however for consistency in the present study I documented instances of silence longer than 10 seconds to cohere with Volet et al.'s framework.

As seen in Table 26 columns 5 and 6 the Fran 160 teams had lapses of silence during gameplay varying from 4 to 22 times per group per session, and the total amount of time per session varying between teams from 52 seconds to 742 seconds. During this first session many team members took this opportunity to get to know one another, resulting in minimal lapses of silence. Session 3 saw an overall rise of instances and total time. An unforeseen factor that contributed to the increase in the third session was the need for students to walk back to the location where their in-progress quest from the previous session was located, which for most teams was the university SUB. Some students had access to playable anywhere content, but most did not, and this would be something to address in future iterations of *Explorez*.

As seen in Table 27 (columns 5 and 6) the Fran 120 teams' occurrences of lapses of silence varied from 0 to 13 times per team per session, and the total time of the lapses per session varied from 0 seconds to 398 seconds per team. The number of occurrences and total time of lapses varied

pronouncedly between teams and the two cohorts. In addition to the game design, other factors at play would include team cohesion and the student's level of comfort with their teammates. The implemented additional game elements appeared to assist to fill potential voids in gameplay while students walked between locations. The video recordings showed that some teams had little need for this type of filler, as they visited with teammates while walking between gaming locations, while for others it did fill a potential void. Additionally, the pop-up elements had another advantageous result of successfully steering the students back to the target language when they had been *off task* and engaged in small talk in English.

4.4.4 Participants use of an online dictionary

As seen in Table 26 column 7, participants in the Fran 160 cohort employed a dictionary or other online language tool during 7 of the 15 recorded sessions, with a total of 28 instances documented on camera. However, it is possible some instances were missed if at any time students employed their own device off camera and made no verbal indication of using an online tool. The highest number of instances of using a dictionary (or online tool such as google translate) was 13 times by team Rouge A during S3. The Bleu C team employed a dictionary two to five times each session, and team Rouge C never once used an online resource. Players most often employed an online dictionary to look up a vocabulary word they wanted to use for creating a twitter post. The majority of the time students would first ask their teammates, and if no one in the group knew the word in the target language, then at times the student would then choose to use an online resource. However, at other times when none of the other teammates knew the sought after word in French, students would instead choose to modify what they intended to say on the recording or find an

alternate word already in their vocabulary to use. This was the case with team Rouge C, in which the participants never used an online resource during gameplay.

As seen in Table 27 column 7 the Fran 120 cohort used an online dictionary or other resource during 8 of the 13 recorded sessions with a total of 35 instances. Again, similar to Fran 160 I may have missed some instances if they occurred off camera. As mentioned previously, the Fran 120 students had access to a vocabulary sheet for gameplay of *VdeUVic* during S1; therefore, S1 documented instances pertain to this sheet, as no team chose to use an online dictionary if the word they sought was not on the vocabulary sheet. At times the accompanying TA provided the translation of gameplay content vocabulary words to assist with comprehension. Team Vert A was the only team to use a dictionary/vocabulary sheet during all three sessions, and this team had the highest number of instances in the Fran 120 cohort during S3 employing an online dictionary 8 times. Teams Bleu A and Bleu B used the vocabulary sheet during S1 but did not use a dictionary during gameplay of *Explorez*. Similar to the previous cohort, the Fran 120 students also first asked their teammates for translations of vocabulary words, before resorting to an online tool. During S1 this cohort employed the vocabulary sheet to comprehend the gaming content. This cohort also used the online resources when creating a tweet for S2 and S3. What differed with these lower-level French students was that they also employed a dictionary to look up vocabulary to comprehend the gaming content, whereas the higher level students mostly employed online tools for unknown vocabulary to create a twitter post.

4.4.5 Percentage of French versus English spoken during the task

The percentage of French spoken by Fran 160 participants during gameplay by each group varied immensely between 14% and 98% of the time. The overall average was 68% of French spoken per team per session. However, as seen in Table 26 column 4, some teams made substantially more effort to remain in the target language than others. Three of six teams had a quite low L2 percentage use during S1 (from 14%-41%), However, two of these teams, Bleu A and Rouge A increased substantially for the next two sessions. After reviewing the video recordings from S1, at the start of S2 the professor and I reminded students that the goal of the exercise was to explore the campus in the target language. Much of the coded *off task* English discussions during S1 were students visiting and getting to know each other as they walked between locations. Another possible contribution to the low percentage of French language use in S1 might have been the students' excitement of being outside the classroom and playing the game. For example, during the end scene when one student (team Bleu C) said "let's tweet about it" another participant from team Bleu A responded "I don't wanna tweet about it (others laugh) I wanna read about and see about it! Look at all the items, let's talk to the mysterious stranger again!" Additionally, when the combined Bleu teams finished *VdeUVic* and participant F18P1 realized there was an alternate ending he said: "Wait, what? We should have spared it! I wonder if anyone else did?"

Participant F18P4 responded: "Wait they still have it!"

Participant F18P1: "Wait don't kill him!" (And ran over to the other teams to hear their ending of the game.) The use of the TL increased by almost 30% for S2. During session 2 the students spoke in French 30%-98% of the time, with an average of 79%. Session 3 saw a slight decrease with the participants remaining in the target language 29%- 93% of the time, an average of 73%.

The percentage of French spoken by Fran 120 participants during gameplay also varied greatly from 6% to 88% (Table 27 column 4). This cohort however remained more consistent with the percentage of French spoken by teams across the three sessions. For example, team Vert A's spoken French usage for the three sessions was between 42%-48%, and the team that used the least amount of French (Team Bleu A) between 6%- 24%. Team Bleu A read the gaming content silently, and then often discussed steps for gameplay in English, while team Vert A read the gaming content to each other out loud in French, and then as much as possible used the French vocabulary available to them to discuss next steps, often code-switching employing both French and English. Once again worth noting is that all cohorts had the final play session at the end of term, and on the video recordings we can hear students from each team comment in some fashion that they are distracted, tired, stressed, and/or excited for the term to end. It is likely this impacted gameplay and the student use of the TL during the last session.

4.4.6 Group cohesion and laughter during gameplay

Instances of laughter during gameplay were initiated by game content, character 'dialogues' and/or participant interactions. These occurrences also depended on the individual players, as well as the team dynamics. As seen in Table 26 column 8, Fran 160 teams laughed from 2-45 times per session. Instances were only coded when two or more team members laughed together. Of the 15 recorded sessions this was an average of 29 instances of laughter per team per session. The Rouge B team's low instances of laughter during S1 was likely impacted by the fact this team did not comprehend the AR trigger and therefore missed the majority of the gaming content. They did stay on task exploring the campus in French but had no access to the gaming content until they met up

for the final scene at the Quad. Rouge A on the other hand had the highest instances of laughter during S2 with 45 occurrences. Overall Bleu C had the highest total of instances of group laughter at 114 occurrences when combining all three sessions, and as noted previously, this is the Fran 160 team that was the most engaged with each other and the gaming content.

The Fran 120 teams laughed from 12-51 times per session, an average of 33 times per team per session (Table 27 column 8). Team Bleu B had the lowest number of occurrences in S1 with 12 instances, likely impacted by the fact this team struggled to comprehend the gaming content of *VdeUvic*. Team Vert A had the highest occurrence in S1 with 51 instances of group laughter. Vert A was the team in this cohort the most engaged with each other and the gaming content, and overall had the highest instances of laughter with 141 occurrences when combining all three sessions.

The number of times two or more team members laughed together was coded in order to assist in the analysis of group cohesion. This draws from Nasir et al.'s study (2015) in which laughter of two or more members within a group during gameplay was documented, as a means to analyze group cohesion between teams playing a game and other teams that did not. The present research does not entail a control group; however, the documented laughter is worth noting given that laughter suggests overall enjoyment and group cohesion, which in turn are likely to impact student collaboration, motivation, and engagement.

Additionally, the instances of laughter in conjunction with the student's self-reports on playing in a group further support group cohesion. In the questionnaire participants were asked about their experience playing *VdeUvic* and *Explorez* in a group. Three of 23 (13%) Fran 160 participants responded it had no effect on the experience, while the remaining 20 students (87%) responded playing in a group had a positive or very positive effect on the experience (see Table

28). In response to the same question, in the Fran 120 cohort, three of 11 students responded it had no effect on the experience (27%), seven participants stated it had a positive effect (64%), and one answered that playing in a group had a very positive effect on the experience (9%).

Table 28. Participants experience playing in a group

	Fran 160	Fran 120	Fran 100
It had a very negative effect on the experience	0	0	0
It had a negative effect on the experience	0	0	0
It had no effect on the experience	3	3	0
It had a positive effect on the experience	17	7	4
It had a very positive effect on the experience	3	1	2
N	23	11	6

In the questionnaire students were also asked how well their team worked together during gameplay. All the participants chose on the positive end of the spectrum with 91% of the Fran 160 participants and 82% of the Fran 120 participants responding “well” or “very well”(Table 29).

Table 29. Participants opinion of teamwork during gameplay

	Fran 160	Fran 120	Fran 100
Not very well at all	0	0	0
Not well	0	0	0
Okay	2	2	1
Well	11	4	1
Very well	10	5	4
N	23	11	6

Questions drawn from Brown's (2008) research on CL were also beneficial in gaining additional information on students' perceptions of the collaborative tasks during gameplay and their group cohesion. The participants were asked to rate on a Likert scale from 1 to 6 (1=Strongly disagree 6=Strongly agree) the extent to which they agreed with statements regarding the CL tasks in *VdeUVic* and *Explorez* (see Tables 30 and 31). Overall student responses were on the positive end of the spectrum. In the Fran 160 cohort 21 of 23 participants (91%) answered that they slightly agreed, agreed or strongly agreed that the collaborative tasks during *VdeUVic* and *Explorez* fostered team spirit. Video recordings further supported this with many participant verbal indicators such as "Yay team bleu!", and all groups posting pictures of their teams to twitter mentioning their respective team's success. In the Fran 120 cohort all eleven students responded on the positive end of the spectrum in regards to the collaborative tasks in *VdeUvic* and *Explorez* fostering team spirit.

Additionally, the majority of students reported that the CL tasks during gameplay helps understanding/comprehension, creates a more relaxed atmosphere, encourages advanced students to help other students, enhances communication skills, allow learners to actively participate in their learning, are fun, and that the collaborative tasks should be encouraged/continued. Moreover, most students disagreed that the CL tasks are a waste of time (explaining things to others). In the Fran 160 cohort, 70% of the students agreed that the CL tasks allow for useful/helpful feedback, and the majority of all other participants also agreed. The students were split on whether the CL tasks are more work for themselves and the group, and if it is difficult to get members to actively participate in tasks.

Table 30. CL tasks (1-6)

	helps understanding /comprehension			creates a more relaxed atmosphere			allows for useful/ helpful feedback			is more work for myself and the group			encourages advanced students to help other students			enhances communication skills		
	Fran 160	Fran 120	Fran 100	Fran 160	Fran 120	Fran 100	Fran 160	Fran 120	Fran 100	Fran 160	Fran 120	Fran 100	Fran 160	Fran 120	Fran 100	Fran 160	Fran 120	Fran 100
Strongly disagree	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Disagree	0	0	0	1	0	0	1	0	0	4	2	4	1	1	0	0	0	0
Slightly disagree	2	2	0	3	1	0	6	1	1	9	5	1	2	1	1	1	3	0
Slightly agree	10	2	2	5	2	1	7	4	1	9	1	1	9	4	1	12	2	1
Agree	11	6	4	11	5	1	8	5	3	0	3	0	5	5	3	6	5	4
Strongly agree	0	1	0	3	3	4	1	1	1	1	0	0	6	0	1	4	1	1
N	23	11	6	23	11	6	23	11	6	23	11	6	23	11	6	23	11	6
mean	4.39	4.55	4.67	4.52	4.91	5.50	4.09	4.55	4.67	3.35	3.45	2.50	4.57	4.18	4.67	4.57	4.36	5.00

Note. Participants perceptions of CL tasks in *IdeUvic* and *Explorez* 1-6

4.4.7 Tweets

Student tweets were also logged for easier reference, with screen capture software used to gather the gaming tweets. Tweets were organized by user and team, categorizing the number of tweets, type of tweet, and length of video/audio recorded tweets and compiled in spreadsheets. As mentioned previously, the Fran 160 students were already using Twitter for class and were therefore already comfortable with the technology. During gameplay groups tweeted from 1- 27 tweets per session with a total of 285 tweets (Table 28 column 2 shows the tweets of the 6 teams recorded during gameplay, additional tweets were also posted by the teams that were not recorded). The average was 9.5 tweets per group per session. Tweet types included videos, audio recordings, pictures and/or text. Regarding the video and audio tweets, the shortest one was 7 seconds (a team ordering the coffee in French Level 1 Quest) and the longest was 2 minutes and 11 seconds (another team explaining what resources are available in the French Department Help Centre Level 2 Quest).

The Fran 120 cohort tweeted substantially less than the Fran 160 cohort. However, these students were not using Twitter in class, and the majority of these students had never before used the microblogging service. As seen in Table 29 column 2 the Fran 120 teams tweeted from zero to 8 times per session for a total of 45 tweets, an average of 3.2 tweets per team per session. Three of the five teams chose not to tweet during *VdeUVic*, however all teams participated with Twitter for the *Explorez* sessions. As mentioned in section 4.3.1 *Students focus of integration during gameplay*, the task element of creating tweets as a team, in response to questions from the gaming system, contributed the majority of high-level co-regulation instances supporting this type of task for L2 learners in the gaming environments.

This chapter discussed the study results first examining player experience details; if students found the gamified tools useful for L2 learning, any issues encountered during gameplay, and which gaming elements participants identified as motivating and useful for their learning. The strengths and limitation of the tools were examined, as well as the relevance of place in mobile gamified environments. Next, participant collaboration was explored via the frequency of three different types of collaborative interactions: language, technology, and gameplay. The adaptation of Volet et al.'s (2009) framework then allowed for a more in-depth analysis of collaborative learning, and the way in which learners socially regulated and processed content during gameplay was examined. Finally, the L2 learners' group interactions in the AR gaming environment were analysed focusing on time on and off task, lapses of silence, participants use of an online dictionary, participant tweets, and the percentage of French versus English spoken during gameplay. The next chapter discusses the findings in relation to the research questions.

Chapter 5. Discussion of Findings and Conclusions

This chapter discusses the findings in terms of the research questions. First, implications for gamified learning design are illustrated by the findings addressing RQ1 and RQ2: *What are the participants' perceptions of their learning experience? Which elements do they identify as useful for language acquisition?* The present study also adds to the body of knowledge with the adaptation of Volet et. al.'s collaborative learning framework for a gamified learning experience. Collaborative learning in gamified AR environments is examined in order to address RQ3 and RQ4: *How do students collaborate in order to complete the tasks? In what ways do L2 learners socially regulate and process content during gameplay?* Benefits and limitations of the AR tools for language learning are further discussed when addressing RQ5: *What are the characteristics of language learners' group interactions in a gamified augmented reality environment?* Implications for the implementation of AR in language learning and teaching contexts is also addressed. Finally, limitations to this research are addressed and potential future research discussed as well as conclusions.

5.1 Implications for gamified learning design and development

As design-based research, this study entailed the design, iterative development, and analysis of two gamified AR systems for French second language learning. *Explorez* and *VdeUVic* were designed to be collaborative, quest-based, and place-based with the intention of creating learning

environments outside the classroom that are immersive, engaging, and contextual. At different locations on campus, players interacted with characters that gave them quests including clues or options to further the storyline. The gameplay interactions were designed to take place either in the form of written text or audio and video recordings, encouraging students to practice both oral and written language competencies. To assess the affordances and limitations of the AR gamified systems, this research examined the learners' perceptions of their learning experience, as well as identifying which elements students found to be useful for language learning. Additionally, the iterative design science framework for the development of the gaming iterations and subsequent testing allowed the opportunity to return to prior stages (such as design and development) during and after evaluating the artifacts. Therefore, after each testing session student feedback and observational data were incorporated in order to address any bugs in the system, as well as improve both language and gameplay scaffolding. The findings of this research offer insights for the development and implementation of AR gamified learning systems.

5.1.1 Participants' perception of the learning experience

In regards to the students' perception of their learning experience, findings supported that the students found the L2 gamified systems to be immersive, engaging, and useful. Tovar et al. (2020) highlight that in an educational context a main benefit of AR is the increase of student motivation, satisfaction and engagement which facilitate positive learning outcomes. The reported top descriptors for *VdeUvic* were fun, interactive, and relevant. Similarly, the participants top descriptors regarding *Explorez*, were fun, useful, and interactive. Overall, the students reported that they found *Explorez* to be the most useful as an FL2 activity when rating the gamified activities

(*Explorez*, *VdeUvic* and Twitter), while the Twitter activities were rated the lowest by all three cohorts. Player experience overall for each of the three sessions fell within the positive end of the spectrum, varying for each cohort. The mean ratings regarding overall player experience for testing groups 2 (Fran 120) and 3 (Fran 100) were slightly higher than the first testing group (Fran 160). This is potentially a reflection on the iterative development process to address issues after each testing session, further supported by a decrease in the percentage of reported difficulties encountered by cohorts 2 and 3. Furthermore, in group 1 the most reported difficulties were technical issues, while students in groups 2 and 3 raised different issues, such as gameplay scaffolding and L2 comprehension.

As Tang and Taguchi (2020) highlight, the value of gaming for learner motivation in an educational context is noted in the literature, however there is still minimal research specifically identifying which gaming elements are useful and motivating for L2 learning. Tang and Taguchi addressed this gap with their study on four gaming attributes in an L2 learning game: context, goals, feedback, and interactivity. The present research also addresses this gap, although the gaming elements examined differ somewhat, as well as the gaming vocabulary.

In order to appeal to the largest demographic possible, *Explorez* includes a diverse range of game elements. Concerning which game elements the participants found to be motivating for their learning, all three cohorts rated collaborating with teammates the highest. This reflects the participants responses in the pre-questionnaire regarding what they find motivating when playing digital games; ‘socializing with friends and other people’ was a top response for all three cohorts (see Table 10). However, in regards to next highest ratings, each cohort chose a different gaming element: completing quests, interacting with game content (characters, videos, objects), or the

treasure hunt aspect and exploring the campus in French. This diversity in responses for motivation during gameplay of digital games is also mirrored in the pre-questionnaire (see Table 10). These same four gaming elements in *Explorez* were also rated the highest in regards to which elements the students felt were useful for L2 learning, however the ranking order changed for each cohort. This highlights the importance of a diverse range of elements as different types of learners and players will be drawn to different extrinsic and intrinsic learning motivators, as well as game elements. These findings mirror gaming research regarding intrinsic motivation and player types (Huizenga 2009; Kim, 2011).

Additionally, similar to Tang and Taguchi's (2020) study, the present findings illustrated that students found both *context* and *interactivity* engaging, motivating, as well as useful for learning. For Tang and Taguchi's study (2020) *context* entailed the storyline and visuals, given that their game is played individually on a computer. For the present study, *context* also included the mobility of gameplay as students engaged in a treasure hunt and explored real-world locations on campus in the TL. In regards to *interactivity*, the different gaming context of the present study not only included navigating the gaming world and interacting with NPCs (as in Tang and Taguchi's study), but also entailed interacting with teammates, as well as the real-world gameplay environment. The combination of these gameplay elements resulted in an engaging and immersive learning environment. Moreover, the findings showed the importance of "place" in location-based AR learning environments.

The findings supported that "place" played an important role in gameplay as well as learning as students drew from the environment around them in response to the tasks at hand. As illustrated in all four excerpts (see section 3.6 *Data illustrations*), the place-based component of

the AR gamified systems played a central role. These excerpts also highlight three emerging themes in regards to the significance of place-based learning in AR games: during wayfinding as students figured out the next gameplay location and how to get there, pre-planning discussions before creating a tweet, and both physical and verbal references to the immediate surroundings while answering questions and/or creating a tweet. These results mirror those of Thorne and Hellermann's (2017) study, further supporting the importance of place in AR learning games. These findings are also in line with previous studies that support that AR facilitates opportunities for authentic language tasks (Parmaxi & Demetriou, 2020).

Additionally, 'place' can contribute to the creation of authentic tasks for students. As Holden and Sykes (2011) affirm "place [context, the environment] is not a mere particularity, an application for academic knowledge, but has a profound influence on what and how we learn and is itself generative" (11). Gee (2007) states that, in an educational context, video games commonly provide a situated learning context:

They situate meaning in a multimodal space through embodied experiences to solve problems and reflect on the intricacies of the design of imagined worlds and the design of both real and imagined social relationships and identities in the modern world... and people get wildly entertained to boot. No wonder it is hard for today's schools to compete (41).

The above also holds true for well-developed gamified learning environments. In the present research 20 of the 22 students interviewed responded "yes" when asked if being outside of the classroom, in real environments (although only virtually francophone) aided in making their learning more relevant or meaningful. Thematic coding showed many students felt that it added a very real aspect to the learning, it assisted with vocabulary learning, and contributed to making the experience fun. Participants also commented that the added sense of realism increased interactivity

and immersion during the experience. These findings highlight the students' reported added value of being out of the classroom, and that the place-based component of the games (which incorporated real-world locations for their L2 learning) assisted in the creation of an immersive, contextual, and engaging learning environment.

Next, Tang and Taguchi's (2020) study also showed that the participants found feedback beneficial for learning, but they did not perceive it as an engaging element. Feedback was not directly addressed with the participants in the present research. The open gameplay, as well as open-ended tasks of creating tweets and answering mostly open-ended questions does not lend itself to the system supplying immediate feedback regarding language use. However, the present study showed the students providing each other with L2 feedback during gameplay, and as mentioned previously collaborating with teammates was the element overall that students found to be the most beneficial regarding their L2 learning. Moreover, the inclusion of multiple choice in-game questions did allow for immediate L2 feedback by means of a buzzer sound for incorrect answers, and a bell ding for correct answers. These pop-up questions resulted in most teams discussing which answer to choose, and some team members debating the answer. The resulting bell ding indicating a correct answer often resulted in team comradery with exclamations such as "Yay team!" or high fives. The resulting buzzer for incorrect answers frequently resulted in laughter and exclamations such as "I told you it was X". Therefore, despite the questionnaire not addressing these multiple-choice questions, observational data showed that most teams were very engaged with this gaming element and subsequent feedback. A participant also added the pop-up questions under the "other" option when asked which elements were useful for language learning

in the questionnaire, and several participants discussed the added benefit of the multiple-choice questions during the interviews.

Furthermore, gameplay feedback in the present research also pertained to in-game hints, quest completion, as well as gaming and language scaffolding to facilitate gameplay for the learners as much as possible. The development of gamified systems for L2 learning must not only include sufficient language scaffolding, but also appropriate gameplay scaffolding. Well-developed video games provide sufficient guidance for beginners at the start of the game, and the level of difficulty gradually increases as players progress (Gee, 2007). Findings showed that participants with gaming experience found the two AR gamified systems to be straightforward, and the gameplay scaffolding appropriate. However, other participants without digital gaming experience at times struggled with gameplay comprehension. Consequently, I simplified gameplay options and progression where necessary, inserted additional in-game hints, as well as created tutorial videos. Cohorts 2 and 3 had substantially less technical issues, and less gameplay issues overall, supporting that the iterative development of the systems after each testing session appeared to improve gameplay comprehension and scaffolding. This highlights the importance of several iterations of playtesting, and the relevance of the Design Science framework, in which the process iteration provides opportunities to return to prior stages (such as design and development) during and after evaluating the learning tools. It is imperative to note that further testing and iterative development would benefit both gamified L2 systems, given that the adjustments and additional gaming elements did not fix all comprehension issues for some players. Also, further language adjustments would be beneficial for lower-level students, or alternatively forming teams for gameplay with at least one strong French language student to assist their teammates.

Finally, Tang and Taguchi's (2020) study showed mixed results concerning the learners' perception of *goals* as motivating and pertinent for L2 learning. In their study, approximately half the participants found the *goals* of game quests and the reward system of collecting game elements (nuts and bolts) motivating and useful. Findings in the present study illustrated that most participants found the quests, as well as the overall goal of exploring the campus in the target language and the treasure hunt aspect to be engaging and motivating for their learning. However, badges scored similarly to Tang & Taguchi's research, with a little over half of the participants stating collecting badges was motivating. Observational data also showed that at least one team per cohort was very motivated by collecting gaming points. These teams chose to do most (or all) of the tasks available for bonus points, and participant comments during gameplay emphasized that they were intent on reaching a "win" state. As mentioned previously, overall, the majority of participants (75%) found collaborating with teammates useful for L2 learning. Additionally, most participants (70%) also found the treasure hunt gaming aspect and exploring the campus in the TL as useful for L2 learning. Approximately half of the participants (54%) found interacting with gaming content as useful for L2 learning.

The findings illustrated that participants found the gamified tools added many benefits to their L2 learning, such as creating a collaborative, more relaxed learning environment, and a contextual learning experience outside the classroom. Additional strengths of the gamified systems reported by the students included collaborating with teammates, the novel learning opportunity, and the repetitive nature of gameplay in both systems contributing to vocabulary learning. In regards to gaming elements, findings also showed that students reported that the narrative, the quests, the AR feature, and characters enhanced the experience. Findings illustrated that the

majority of participants found collaborating with teammates, exploring the campus in the TL, and the place-based aspect of gameplay both motivating and useful for L2 learning. However, obviously not all participants found these activities to be motivating and useful. Students who did not engage well with the gamified systems also reported that they preferred traditional learning styles in the pre-questionnaire. Furthermore, one of the two participants over the age of 35, felt that the gameplay was more suited for younger learners, such as high school students. Another student stated that they found the twitter activities to be stressful, and felt social media was “a waste of time”. It is important for developers to design gamified systems based on research and when appropriate include a diverse range of game elements, in order to appeal to the largest demographic possible. However, there will always remain factors outside of the developers control that may contribute to students’ perception of these learning tools, such as individual traits, learning style, and attitude towards technology.

5.1.2 Game design, development lessons and insights

The majority of gamified learning studies do not include design and development details. As Holden and Sykes (2011) state “[l]earning to design and create better games would seem to be somewhat removed from the agenda of this writing, and so one wonders how educators might begin to improve their skills and reputations” (11). Thus, to continue to further this body of research, it is important to also include any lessons learned or insights gained regarding design and development. In addition to the details provided in section 3.1 *Gamified Learning Systems* regarding the development of both gamified systems for the present research, the following also

provides additional insights gleaned that may be beneficial to other developers of gamified learning systems regarding hacks, avatars, feedback and scaffolding as well as technical issues.

5.1.2.1 Hacks

An integral step in designing digital games is storyboarding, which is a graphic organizer showing how the game will unfold (LaMothe, 2021). This brainstorming step is also essential for designing gamified learning systems and is a means to visually plan out elements such as overarching narrative, quests, and goals. Additionally, the organizational method during development is equally important. Such a feature is built into the ARIS platform, with the UI main screen *scenes*. As mentioned previously, quests in *Explorez* were developed within their own scene, meaning all the gaming elements for each quest were contained in a separate scene. This type of visual means to organize quests, gaming elements, as well as the triggers for gameplay progression is an immense asset for developers. Furthermore, for those developing place-based systems with gaming elements that build on previous completed tasks and/or quests, creating a hack to troubleshoot issues is quite possibly vital. The development of gamified learning environments is a highly iterative process, and requires many adjustments in the final stages, especially when elements are location-based, as is the case in *Explorez* and *VdeUvic*. For some gaming triggers in location-based systems the only way to verify updates and changes is to physically go to the locations and test all the elements. In *Explorez* an additional scene was created containing hacks for each quest, and the necessary gaming elements to trigger each quest (conversations or badges). When the system builds on previous gaming elements (quests, tasks) these type of hacks are necessary so that the developer does not need to play through every quest to get to the one which needs testing. This

also highlights the necessity of piloting gamified systems, preferably with individuals with different technical and gaming abilities to assist in identifying any design issues before conducting the study and/or first official playtest session.

5.1.2.2 Avatars

As detailed in section 3.3.1 *Explorez* combines several different online tools (Voki, Twitter, YouTube, FrancoToile). In regards to gamified learning systems, integrating online resources and learning tools is an option for instructors with limited technical resources or abilities. Vital to the present research was the Voki classroom subscription. Voki is an economical and simple way for non-coders to include in-game talking avatars. These avatars contribute to overall gameplay and interactivity, and for L2 games allow for increased in-game audio comprehension. The Voki avatars can be directly integrated into some platforms by means of the auto-generated link. Unfortunately, direct integration did not work with the ARIS platform, but screen recording the avatars, and then uploading these videos into ARIS was a way to overcome the issue. A potential limitation of employing these avatars, as mentioned by a few participants, was that at busy locations (such as the café in the SUB) students found it difficult to hear what the avatars were saying. This however is not a reflection of the Voki tool, but a potential issue for developers to consider when developing place-based learning environments/games. As one participant mentioned, wearing earphones would resolve the issue, however this is not conducive to games designed to be played in a group. Another option would be additional coding to increase the audio level of avatars situated at busy locations, yet this may be awkward or disruptive to others when the location isn't busy and loud. Alternatively, of course developers may instead choose different

locations for their gaming elements when certain places are prone to be busy and loud. However, if desired gaming locations have the possibility of being busy, another solution is the inclusion of optional text, in addition to the speaking avatar. For the present research the option of the player reading in text what the avatar has said was a means to address this issue. Therefore, after every avatar ceased speaking, one of the gaming prompts offered was an option such as “Je n’ai pas compris/I didn’t understand,” as one of the choices. If the players understood what had been said, they could choose another option to continue with gameplay progression; however, if they did not understand or could not hear the dialogue clearly, they could choose the option to read the text of what the avatar said.

5.1.2.3 Feedback and scaffolding

Effective feedback and scaffolding are also imperative to a successful system. The gaming system must provide appropriate and sufficient feedback, and also take into account that the player may or may not have previous gaming experience. Game feedback is instantaneous and tells the player if they are engaging with the system as intended (Gee, 2007). For example, in *Explorez* the requirements for each quest in the system are visible in the Quest Log and the system automatically provides the player with the message "Quest Completed" once they have completed the task. As Sykes, Reinhardt and Thorne (2010) state: “[e] specially relevant to language learning is the task-based approach to quest completion. . . and the importance of failure states to provide meaningful, relevant feedback”(123). In *Explorez*, an example of this type of automatic feedback is supplied in the quest “Trouver le bon café,” when a player chooses the wrong coffee. Only one of the three coffees that appear on the map is an Americano (the coffee the celebrity has requested) and is

accepted by the system as the correct “answer”. If a player picks up the wrong coffee, the NPC Bernadette responds “Ce n’est pas le bon café. Allez chercher un café américain.” The pop-up in-game multiple choice questions and their different sound effects to indicate correct and incorrect answers are another example of this type of feedback.

The ARIS in-game Quest Log was effective scaffolding for players during Perry’s (2015) study; however, this ultimately was not the case for the present research. Most quests include several steps for completion. In the original *Explorez* student recordings, usually the final step of a quest, were done directly in the ARIS “notebook”, and thus triggered quest completion. However, the notebook function had several issues when developing for the present research; it was not stable, it employed GPS to trigger quest completion (which was not stable in indoor locations), in the updated ARIS 2.0 notebook recordings were automatically placed on the gaming map (causing clutter and confusion for other players), and the ARIS platform no longer offered the option for educators to download these recordings to review after gameplay. These issues played a role in Perry et al.’s (2015) study of employing Twitter to extent collaborative potential in ARIS place-based games, which illustrated Twitter’s potential as an in-game tool for gamified systems. As with the first version of *Explorez*, the iterations for the present research included the Quest tab with all necessary information for quest completion. However, for the majority of participants in cohort 1 (Fran 160) not versed in digital gaming this proved to be insufficient gameplay scaffolding. Therefore, I immediately revised gaming location cues before the next gaming session, by adding additional in-game hints that automatically popped up or by changing the trigger for player progression to include an accessible hint. Players not requiring assistance could simply continue and ignore or bypass these gaming hints, but those needing assistance had

immediate access. A straightforward and effective means to address gameplay and language scaffolding was the AI NPC that provided hints and clues.

Originally, I was concerned about breaking the fourth wall with the addition of this AI character. I was apprehensive that this NPC might negatively affect the player experience, given that he did not fit into the narrative, and he acknowledges that the students are participating in gameplay. However, necessity prevailed as this NPC was the most efficient and straightforward way to relay information that the players needed without requiring additions to the narrative in order for it to make sense to the overarching story. I also wanted to relay the information in a concise and straightforward way, and not give the players a substantial amount of additional text to read. Video data showed that the players easily accepted this NPC, and quickly correlated that this character was the go-to when needing additional gaming information.

Feedback within both gamified systems illustrated ways to employ elements of game design into educational contexts, as Kapp (2012) attests: “continual feedback to learners in the form of self-paced exercises, visual cues, frequent question-and-answer activities, a progress bar, or carefully placed comments by non-player characters” (68). The AI NPC ultimately played many different roles as the iterative development progressed; providing hints, popup questions or tasks, multiple choice vocabulary questions, as well as translations and vocabulary for lower level players thereby assisting in adapting the systems for different levels of learners. Some of these gaming elements were also strategically placed in order to fill potential silences when students were walking between gaming locations (a possible issue noted by Perry [2015] and J. Sykes, personal communication, June 25, [2018]). Employing the AI NPC in this fashion (supplying popup questions or tasks) appeared to be very successful. Although some teams did not require this

type of filler, many teams benefited from these additional gaming elements. These gaming elements also had the unexpected advantage of steering most students back to the target language when they had been engaged in small talk in English.

Another form of feedback mentioned above was the use of JavaScript to include in-game sound effects and vibrations when triggering gaming elements or the instantaneous instant feedback of the buzzer for incorrect answers or the bell for correct ones when answering the multiple-choice questions. Findings showed that the sound effects and vibrations enhanced gameplay and were especially important so that players knew when they had accessed game content hidden from the map while walking between locations. These findings also reflect previous research on digital games, as Wood et al. (2004) state:

[o]ne of the main overall findings was the importance of realistic (good quality) sound, graphics, and setting. It is perhaps not surprising that realistic sound effects and speaking characters were identified as important to the respondents. Sound effects are one of the main interfaces of video games and a part of the basic overall structure of virtually all games” (7).

In order to create an engaging relevant learning experience, this type of learning tool should include both well designed gaming elements as well as learning content. As Reinhardt (2019) highlights, the development of educational games is an interdisciplinary process.

5.1.2.4 Technical issues

The iterative nature of developing this type of learning system is also needed in order to address technical issues, bugs and glitches. Bugs and glitches are a common occurrence when developing digital games (CSAgents, 2019). Similarly, developers of digital learning systems should be aware that it is highly likely that they too will encounter these types of issues. Tovar et al. (2020) note

that technical issues are a common challenge specifically with AR learning environments. It is important to allow sufficient time for iterative playtesting, and if possible, have a variety of individuals (with different gaming and language proficiencies for L2 systems) playtest the games. According to Martin, et al. (2015) “you can never test your ideas enough, find ways to test them early and often...Look for student volunteers to play ahead of structured times too, many students are excited to help and can provide valuable insights” (31). As Martin et al. stress, iteration (iterative design, development, and testing) is the most important advice for those intending to develop mobile learning systems.

When possible, less complex is best, as I learned during testing with cohort 1 of the present research. One Fran 160 team experienced a bug which resulted in a gaming loop during session 1 of *Explorez*. Despite spending a substantial amount of time trouble shooting the issue, ultimately, I could not figure out what exactly was causing the problem. This game loop bug would occur sometimes when playing through following how the team progressed during gameplay, and other times it would function properly. Ultimately, I inferred that it was likely on the ARIS end, and simplified gameplay progression and the choice options for the players which avoided the issue. The KISS principle (Keep it simple and straightforward—though there are other variations) is employed in a variety of disciplines, such as interface design, and software development, and adheres that “[w]herever possible, complexity should be avoided in a system—as simplicity guarantees the greatest levels of user acceptance and interaction” (Interaction Design Foundation, 2021). Ultimately video data also showed that this simplification would likewise benefit gameplay. It can be difficult to balance offering player/learner choice and gaming content while deducing the

level of gameplay complexity appropriate for your target audience. Again, this is best addressed by iterative playtesting.

A significant technical issue in the original *Explorez* was the instability of using GPS triggers for indoor gaming locations. This sort of technical problem can be a common issue for location-based AR applications. As Akçayır and Akçayır (2017) note, these types of GPS errors involve AR systems “miss-perceiving a location and/or direction...[or] low sensitivity in trigger recognition” (7). Using QR codes would of course avert this issue, however, as was the case for this research, it can be difficult to get permission to place QR codes in public spaces on a university campus. Additionally, if placed in public spaces, the developer would also have to check all QR codes before each session of gameplay to ensure that no one had tampered with them. With the addition of ARIS AR camera overlay feature, all the indoor gaming locations were made stable. If gameplay requires triggers in a place-based system, the AR camera overlay feature could be considered a must if playing in public spaces. Another tech issue is a potential lack of adequate Wi-Fi. For place-based learning games sufficient Wi-Fi or access to data are a necessity. From 2015 student playtesting I was aware that the Wi-Fi on the UVic campus was not stable enough for mobile gameplay. Therefore, for the present research, cohort 1 used their own devices for gameplay (BYOD) and cohort 2 and 3 were supplied mobile devices with access to data.

Finally, more common technical issues encountered during playtesting were the system freezing at times or crashing or slow loading times for game content. Twitter also crashed a substantial amount during the first testing session, and therefore was removed from the in-game player tab and instead students were directed to double click the home button to directly access Twitter in a new window on their device during gameplay (as mentioned in section 3.1.4.2

Challenges with Twitter). Players with gaming experience did not seem deterred by these issues and reloaded the systems without prompting. However, other students not as game nor tech savvy appeared frustrated at times and some needed to be reminded to reload when these types of issues occurred. Tovar et al. (2020) note that “[o]ne of the main challenges when testing the AR tools was the difficulties students experience when using AR (i.e., usability, application-related and technical problems), which may increase the time required for learning and the cognitive load of the students, hampering their motivation and performance” (15). With the iterative development between testing sessions, the occurrences of technical issues during gameplay were less with each cohort, and although major problems were addressed and resolved, unfortunately not all bugs were resolved. Work arounds were developed for the bugs that affected gameplay and students were warned of ones that occurred occasionally but had not successfully been resolved entirely. The in-game hack to access all quests (as well as points and badges) proved very useful when severe technical issues affected student gameplay. I could quickly and easily return previously earned points/badges to players and also resume gameplay at the correct quest so that students did not need to start over if a tech issue was not resolved by reloading.

5.2 Collaborative learning in gamified AR environments

In regards to L2 learning, Godwin-Jones (2016) asserts that AR gameplay requiring collaboration and communication is a “no brainer.” The present research sought to examine the collaborative learning potential in gamified L2 AR environments. As described previously (section 4.2 *Participant collaboration*) the ways in which students collaborated to complete the tasks in the learning environments was examined, as well as the students’ learning patterns. The learning

patterns were explored by means of the adapted framework of Volet et al. (2009), which was informed by social regulation and content processing (see section 4.3 *Participant collaborative learning*). Findings showed that the AR gamified systems provided significant opportunities for collaborative learning. The findings also illustrated distinct types of learner interactions amongst teams during gameplay. Furthermore, this study identified patterns in the emergence of learners' high-level co-regulation during collaborative learning, as well as potential factors contributing to students sustaining engagement of high-level co-regulation episodes.

Given the nature of the gamified activities, in that participants interacted with each other as well as the learning tools, the first level of coding the transcribed video data entailed identifying collaborative episodes regarding the *target language*, *technology use*, and *gameplay*. This analysis showed the frequency of the identified types of collaborative interactions during gameplay. *Collaborative target language* episodes pertained to students assisting each other with vocabulary, grammar or pronunciation in the target language. *Technology use collaboration* entailed students assisting each other with navigating the user interface, interacting with gaming objects, or using the Twitter functionality for making voice recordings. *Gameplay collaboration* involved participants discussing gaming content, and next steps for gameplay progression, deciding together how to proceed or making specific choices prompted by the system. Students more familiar with the campus assisted their teammates with directions when looking for physical locations, and some students worked together using the map function to figure out the next gameplay location. Additionally, participants worked together to complete tasks; for example, discussing a Twitter post's content before commencing the recording, and then at times also dividing the task amongst

themselves so that each participant addressed an element of more complex tasks, thus each one contributing a portion of the necessary response to the recording.

The findings for this analysis suggested the potential of the AR gamified environments to facilitate high levels of interaction and collaboration. These findings are in line with previous studies on AR in an educational context (Akçayır & Akçayır, 2017; Kamarainen et al., 2013). Video analysis illustrated that different player and learner types affected the collaborative interactions of the teams. Some team members were very engaged with each other, and the gaming content, and in result engaged in a high frequency of collaborative episodes: Fran 160 Bleu C, up to 61 times during one gameplay session, Fran 120 Vert A up to 77 times, and Fran 100 Bleu A up to 51 times. The findings also corroborate previous research, as seen in Liu et al.'s (2016) study, that “[b]ecause the students were provided with multiple opportunities for interaction throughout the game in a semi-structured, open-world setting, they were able to engage in dynamic interaction to solve the challenges they faced” (374). Students in the teams that engaged in high levels of interaction and collaboration took turns reading game content out loud, assisted each other with completing tasks, and discussed gaming content and next steps of gameplay. These students also discussed what they wanted to post to twitter before creating the post, and then each student contributed, with each team member speaking on the recording. When there were pop-up questions, the question was read out loud and the students took the time to choose an answer together or other times debated which answer to choose when they were not all in agreement. Findings further showed that interactions for these students were often several consecutive turns between speakers. These described collaborative episodes reflect Rodríguez et al.'s (2017)

definition of CL as an approach that “involves groups of learners working together to solve a problem, complete a task, or create a product” (665).

In sharp contrast to the previous examples, a team from each cohort had substantially fewer instances of collaborative episodes compared to their peers during gameplay. In these teams often only one member would read content out loud, and the student wearing the GoPro held the mobile device the majority of the time. There were also several instances of team members gathered around the device reading content silently. In contrast to lengthy interactions with several consecutive turns between speakers (as seen with the highly collaborative teams), many of the interactions were instead quite brief. These were instances of a single turn between two students, such as a team member asking a question, and another teammate responding with a brief answer. In the Fran 160 team, while walking between locations the participant holding the phone at times read content silently, and then push through without sharing the information with his teammates. This team, however, engaged in an increasing number of collaborative episodes for each consecutive session. Group cohesion appeared to improve as well, as the other two students made a substantial increase in verbal contributions and actively participated in the gaming tasks. The two teams from Fran 120 and Fran 100 had an additional challenge in that the team members did not share the same first language. This may have impacted student interactions given that other teams reverted to English (the majority of participants first language) or code switching between French and English when they lacked the vocabulary to express themselves in the TL. The remaining teams’ interaction level fell between the two previous type examples. The level of interaction and collaboration appeared to depend not only on the game design and the students’

personas, but also the students' comfort level speaking the L2, teammates sharing the same first language, group cohesion, as well as player types and learner styles.

Bressler's (2015) DBR research on her multiplayer forensic mystery *School Scene Investigators* AR game also showed two ends of a spectrum; some teams collaborated very well, and others hardly at all. Bressler (2015) reports that "while the game scaffolded collaborative problem solving using the jigsaw technique, the game design did not require students to discuss the information. Many students naturally and willingly discussed their evidence, but not everyone did, and those who did not had greater difficulties" (95). Bressler's (2015) game was designed to support collaborative problem solving and reduce potential group problems by employing a jigsaw technique which divided up the quests between players, and also gave players different paths of evidence to follow. Bressler's design intent was that: "[t]he student who might be inclined to take control of the situation (the hog) could not direct the group unless he or she had a quest. In a similar vein, the student who might be easily overpowered in a group (the log) had a voice and responsibility because each player followed a unique line of evidence" (95). While Bressler's game was designed to support collaboration, findings showed varying degrees of collaboration, similar to the present research, which further supports that many factors, not game design alone, impact player collaboration.

Employing a jigsaw technique is one viable design method to promote student interaction and collaboration. In the present research, additional iterative game design and development to further encourage collaboration, and students taking turns holding the device may also assist in an increase of interactions. As mentioned previously, one student per team was wearing a GoPro to record the student interactions with each other as well as the tools. This was perhaps not conducive

to students taking turns holding the device. However, it is unknown to what extent this may have actually affected some of the students and their interactions, if at all. The highly collaborative teams showed no issues taking turns reading gaming content out loud or handing the device off to another teammate all while keeping the iPhone in the viewing range of the head mounted GoPro most of the time. Further research in the design for gamified collaborative learning systems, as well as increasing group cohesion would be beneficial.

Additionally, the findings illustrated participants from all three cohorts engaging in collaborative episodes regarding *language*, *technology*, and *gameplay*. Overall *gameplay collaboration* had the highest number of occurrences for all three cohorts. Designing the two systems to create opportunities for students to work together and promote collaboration appeared to be successful. This may support that the design and development of these types of learning environments drawing from previous collaborative digital games research (see Rocha, Mascarenhas, & Prada, 2008; Seif El-Nasr et al., 2010) is an appropriate and advisable option when creating gamified collaborative learning systems.

Specifically, regarding the frequency of the collaborative episodes, findings showed that the Fran 120 teams average of language interactions was almost double that of the Fran 160 teams (an increase of 94%). This is likely due to the fact that Fran 120 students needed peer assistance regarding understanding the gaming content, as well as engaging in tasks and creating tweets, while the Fran 160 students mostly assisted peers when creating a tweet or answering questions. Pertaining to collaboration and a technical aspect of the tools, findings showed that Fran 120 participants engaged in 51% more of these types of interactions compared to the Fran 160 cohort.

This too is not surprising given that the Fran 120 students were not already using Twitter in class, and therefore most were learning both Twitter and the gaming platform.

Findings regarding the Fran 100 cohort showed that overall these students' frequency of language collaboration fell between the other two cohorts. However, as mentioned previously, two of the three teams relied more on the accompanying language expert than on each other for language assistance. The third team included a student very versed in using the online dictionary. This team had the highest use of a dictionary out of any of the cohorts, employing this online tool 31 times during the two sessions playing *Explorez*. The majority of the students in this cohort had substantial experience in both gaming and technology. Not surprisingly, this cohort had the least number of instances assisting each other regarding a technical aspect of the tools of all three cohorts. Also, worth noting is that the Fran 100 teams progressed as far in *Explorez* as those in Fran 120. The Fran 100 cohort's strong technical and gaming knowledge assisted the students greatly despite their struggle with the higher level of French language gaming content. The frequency of gameplay collaboration remained fairly similar for all three cohorts, with a 15% or less difference between cohorts: Fran 100 averaged 20.8 times per team session, Fran 120 averaged 24.5 times per team per session, and Fran 160 averaged of 19.1 times per team per session. All cohorts engaged in a high frequency of gameplay collaborative episodes during the sessions, further illustrating the potential of AR gamified learning environments.

These findings supported the potential of these AR gamified environments to facilitate high levels of interaction and collaboration. As Dunleavy et al. (2009) highlight, one of the main affordances of AR immersive environments is their potential to increase learner interaction and engagement. However, despite the findings illustrating the frequency of student collaborative

interactions, they did not consider the duration of each instance. Therefore, for a more in-depth examination Volet et al.'s framework was adapted for the next research question; to further examine collaborative learning.

5.2.1 Patterns of collaborative learning

Using Volet et al.'s framework, this research also sought a deeper examination of the potential of collaborative learning in place-based AR L2 gamified environments. The adapted framework, which examined how students socially regulate and process content, was found to be useful in identifying patterns of interaction during gameplay of the AR L2 gamified systems. The analysis showed prominent differences in patterns of collaborative learning across groups and sessions. The findings also identified contributing factors to the emergence of high-level co-regulation, as well as potential factors that aid students in sustaining high-level co-regulation during gameplay. By means of identifying both high and low level co-regulated content processing, the findings also highlight that students participating in active collaboration also rely heavily on low-level co-regulation during gameplay. Although research supports that high-level co-regulation is the most effective means of collaborative learning (Volet et al., 2009), in regards to language learning low-level content processing is also an important factor (Nassaji, 2014). Additionally, the highly interactive nature of the AR gamified systems, as well as the collaborative potential during gameplay support a sociocultural theory lens, focusing on the social nature of language learning and emphasizing learner interactions as a principal learning force (Lantolf & Thorne, 2006).

Moreover, the adapted framework allowed for an examination of students focus of interactions across the groups and sessions. Findings showed that students spent a substantial

amount of time processing content. Fran 160 teams observable focus on content processing during gameplay was 56.2% to 85.7% of the time. Other gameplay, such as conversing in the target language, watching French videos with the intent to understand the content, and interacting with the L2 gaming interface constituted 1% to 23.9% of the time. Several of these other gameplay elements can arguably be included as content processing for second language learners. Findings showed that when *gameplay processing* and *other gameplay* were combined, the potential for content processing increased from an average of 67% to 83% of the time per team per session. In the Fran 120 cohort observable gameplay content processing was 43.4% to 85.1% of the time. Similar to Fran 160 groups, *other gameplay* also varied greatly amongst the Fran 120 teams and constituted 2.4% to 48.7% of the time. For these students, in addition to conversing in the target language, watching French videos with the intent to understand the content, and interacting with the L2 gaming interface, even tagging, and posting a tweet for those not yet versed with the technology was also acquiring new knowledge, and thus another element of content processing. Parallel to the Fran 160 cohort, the combination of both *gameplay processing* and *other gameplay* increased the overall potential content processing time of Fran 120 teams, from an average of 60% to 79% of the time per team per session.

Similar to Volet et al.'s study, the present research partially supports that subsequent sessions allowed for an increase in collaborative learning opportunities. In the Fran 160 cohort, team Rouge C's high-level individual content processing remained fairly consistent for all 3 sessions, but this team's high-level co-regulation engagement over doubled from S1 to S2 and increased again slightly for S3. Team Rouge A saw an increase in high-level co-regulation from S1 to S2 and then almost tripled in S3. These teams also showed improvement in team dynamic

over the three sessions, and as such supports the potential of facilitating increased opportunities of collaborative learning. Yet Bleu C, the team with the highest number of collaborative instances (see Figure 10) saw a decrease in Session 3 regarding high-level co-regulation content processing. As mentioned previously there were many factors at play. Given that Dave states “it’s so hard to speak French today. My brain is elsewhere,” the fact that it was the last day of class, and the students were preoccupied by other end of term responsibilities (part of their *off task* discussion) may have influenced the students CL potential.

Regarding the Fran 120 cohort, the data from the framework was less clear whether subsequent sessions allowed for an increase in collaborative learning opportunities. The different gamified systems affected this, as teams Vert A and Vert B engaged in substantially higher levels of high-level co-regulation during S1 than any other teams in both cohorts; illustrated while the students worked together through the end scene of *VdeUvic* in order to comprehend the story, and then decide together how to proceed. During S2 and S3 with *Explorez*, all three Fran 120 teams had higher amounts of low-level co-regulation than the Fran 160 cohort. The Fran 120 teams spent substantial more time working together to understand the gaming content, and thus comprehend the L2 content. It is likely that more instances of coded low-level co-regulation were in fact high-level co-regulation, as students worked to comprehend the tasks at hand, linking ideas and seeking understanding. As Kukulska-Hulme and Viberg (2018) highlight “even a simple practice conversation in the target language could be seen as working together to solve a problem (i.e. overcome unwillingness to communicate), complete a task (i.e. understand and be understood) or create a product (i.e. produce correct target language utterances)” (208). However, without strong identifiable markers to support this, such as clear verbal indicators, I erred on the side of caution

and these instances were coded as low-level. Teams Vert A and Vert B did however engage in an increased level of high-level co-regulation from S2 to S3. In relation to the fact that all three teams also showed an increase in collaborative gaming episodes from S2 to S3 (as seen in Figure 11), this potentially supports that subsequent sessions allowed for an increase in CL opportunities.

5.2.2 Factors contributing to the emergence of high-level co-regulation

In regards to the emergence of high-level co-regulation content processing, the majority of the time these episodes were preceded by a question or explanatory statement. Therefore, despite the very dissimilar learning context (that of L2 mobile learning gamified environments in comparison to the analysis of a medical clinical case) the present research findings paralleled those of Volet et al.'s. In the context of the AR place-based learning game, the game design played an important role. High-level co-regulation content processing episodes emerged when students responded to certain gaming prompts, as well as open ended questions. Thus, this research addresses Parmaxi and Demetriou (2020) call for future research in AR L2 learning to consider guided gameplay interaction: “[f]uture AR designers need to pay more attention to scaffolds that may sensitize students to critically discuss emerging ideas and create opportunities for deeper processing of the information and more productive learning” (871). Additionally, a large majority of high-level co-regulation content processing instances arose during the task of creating a Twitter post in the target language, which often resulted in the students first discussing the content they should include, and then creating the tweet. This supports the learning potential of not only the AR gamified systems, but also the use of Twitter for gaming tasks and L2 learning. This also echoes the many potentials

of Twitter as a tool for language learning for both input and output production, with interactions in the form of written text or audio and video recordings (Rosell-Aguilar, 2018).

5.2.3 Factors contributing to sustaining high-level co-regulation

The qualitative close examination of a lengthy episode of high-level co-regulation highlighted four potential factors that appeared to contribute to the students sustaining the engagement of high-level co-regulation: *asking questions, tentativeness of explanations, background knowledge, and shared positive emotions*. Again, despite the different learning context, this exploration of potential contributing factors to sustained high-level co-regulation in group interactions during gameplay mirrored Volet et al.'s previous research.

During gameplay, *high-level open-ended questions*, which were either proposed by the gaming content or the students, often instigated then contributed to sustaining group engagement in high-level co-regulation. Additionally, similar to Thorne's (2008) research, the students in the present study illustrated that their negotiation of meaning during gameplay included requests for help, comprehension checks, and corrective feedback.

Participants' *tentativeness* and openness throughout gameplay, also assisted in sustaining high-level co-regulation. In the gameplay context, *tentativeness of explanations* was illustrated by means of requests for help, offering suggestions in the form of indirect questions, and when the students gave each other corrective feedback. In educational psychology literature such *tentativeness* is also described as *openness* and *non-defensiveness* (Volet et al.). Thus, the group dynamics must also allow for peer assistance, and the students be open and willing to give and accept assistance.

During student group work *background knowledge* can also increase high-level contributions to constructing knowledge (Volet et al.). This parallels the sociocultural perspective focusing on learner interactions as a primary learning force. Moreover, it reflects the concept of scaffolding, which in language learning defines collaborative peer L2 learning, regardless of the skill levels of the learners (Lantolf & Thorne, 2006). The learners take on the roles of experts and novices and assist each other by means of scaffolding through peer interactions (Ohta, 2000). Consequently, a learner is able to achieve more by collaborating with peers, than what they could accomplish on their own.

Positive emotions can increase commitment to the group (Lawler & Yoon, 1993), and laughter is thought to be a tool in building social cohesion (Robinson & Smith-Lovin 2001). The findings suggested this in that the teams with very high occurrences of group laughter during gameplay also appeared to work well together and self-identified their teamwork as successful. Additionally, despite many groups frequently engaging in laughter and humour, the majority remained on task, and their demeanors appeared playful, open and non-defensive. Participants *shared positive emotions* and laughter appeared to play a role in sustaining their high-level knowledge construction. The findings supported that the place-based AR gaming environments created significant opportunities for students to engage in high-level co-regulation. Learner collaboration during gameplay is of course dependant on many factors, including but not limited to the students, the type of learner/player, group cohesion, and game design.

5.3 Language learners group interactions in a gamified AR environment

This research also explored the affordances and limitations of the AR tools for language learning by examining the characteristics of the students group interactions in the gamified AR environments. Transcriptions of the video data were coded with markers which identified the duration of gameplay (which can be used to ascertain player progression for comparison), the percentage of time on and off task, lapses of silence during gameplay, the use of an online dictionary, the percentage of French versus English spoken during the task, the number of times two or more group members laughed during gameplay, and student tweets.

5.3.1 Interactions through Gameplay

During gameplay most teams progressed as intended in both gamified systems. In regards to *VdeUVic*, despite the many set-up issues faced at the start of S1, the Fran 160 teams had ample time to complete gameplay. However, the allotted playtime for the Fran 120 cohort was not sufficient. As Martin, et al. (2015) attest, designing mobile learning experiences must consider many factors beyond the learning content: “for designs that involve outdoor activities or exploration, time management has additional features. It is important to consider the act of traveling to and between destinations, balancing time spent doing things on devices with other activities like debriefing or walking” (30). In the context of an AR L2 tool the players language level and any additional time needed to read and/or comprehend L2 content is another time consideration. Additionally, if students are not self-selecting their groups, forming teams with students who have varied language competencies is also advisable. *VdeUVic* ultimately contained too much unknown vocabulary for many of the lower-level Fran 120 students, therefore in addition

to more time, these teams also required a stronger student who could assist their teammates with comprehension in order to truly understand the storyline.

Overall, the students progressed as anticipated during gameplay of *Explorez*, and the gaming content appeared suitable for both levels of FL2 learners. Although no students completed *Explorez*, most Fran 160 teams reached a Level 3 Quest, and a couple of the Fran 120 teams also began a quest in this final level. As expected, students progressed farther during their first session of *Explorez*, completing more quests than the second session; the quests in Levels 2 and 3 become more complex, and thus take more time to complete. Findings showed that the Fran 120 teams progressed almost on par with the 160 students at the first level of *Explorez*. However, once Fran 120 students reached Level 2 of gameplay, the majority of students required more time to read through and comprehend the gaming content. The higher-level quests were definitely challenging for the Fran 120 students; however, by asking each other questions and working together to understand what was required, most teams comprehended the gameplay content.

As discussed in section 5.2.1 *Patterns of collaborative learning*, in L2 gamified learning environments students CL is not limited to the *target language*, but also pertains to *technology use*, and *gameplay*. Therefore, despite the focus of the activities centering on L2 learning, another factor which may impact the learning experience is the technical competencies of the students. As Martin et al. (2015) assert, when developing AR tools, it is important to avoid the “digital native” fallacy, and not assume learners are proficient in using technology, simply because they grew up with it: “despite students’ typical familiarity with mobile devices and videogames...something like an AR game is just as alien to them at first as it may have been to you (39)”. Consequently, in the present research, the findings suggested that the in-game tutorials appeared to facilitate

gameplay using the ARIS platform and Twitter. The findings also illustrated that teams with a member versed in gaming and technology encountered substantially less difficulties during gameplay. Therefore, if possible, forming teams to include members with these varied competencies may also facilitate the experience. In any case, the students became more comfortable with the technologies in subsequent sessions.

5.3.2 Interactions during time off task

Since the overarching goal of the learning activity was to explore the campus in the target language, in regards to learner choice, the time students spent in small talk in English was considered to be *off task*. During each cohort's first session, the learners' intentions appeared to be getting to know one another during the majority of the *off task* small talk. In regards to learners building group cohesion to facilitate CL, these types of interactions would be viewed as encouraging. Especially since *VdeUVic* was designed to serve as a team-building exercise, with objectives including collaboration and team cohesion. However, in the context of an L2 activity, one would hope the students would strive to have these conversations in the TL, provided of course they have the language competencies to do so. Nonetheless, *off task* was minimal (less than 5% of the time). During the first session of *Explorez*, the amount of time students in both cohorts spent *off task* decreased to almost nil (1% of the time). This suggests the overall effective design of *Explorez* as a gamified L2 environment. Session 3 saw an increase *off task* for most teams, likely

impacted by the fact it was the end of term, as well as a design hurdle¹² to consider when gameplay for students is broken up into multiple sessions.

Although students choosing to silently read gaming content is not considered *off task*, it does hinder opportunities for the learners to collaboratively work through and comprehend gaming content. The majority of students with the higher-level competencies read the gaming content out loud, while the lower-level Fran 120 participants chose to silently read game content noticeably more (7% of gameplay time). Findings showed that for some of these lower-level students, apprehension regarding reading out loud and possibly making mistakes impacted this choice. Additional gaming elements may encourage some students to read content out loud more often. For example, prompts that ask participants to share the task by taking short turns, and then indicate to players when they've completed their section. In addition, the enticement of bonus points for the task would be motivating for some players.

Nevertheless, findings in the present research showed that overall participants spent the majority of time on task with up to 83% of gameplay time spent processing content. Thus, this research supports previous findings in which construction of knowledge in the AR learning environment is achieved through high levels of interactions with other players as well as the environment in “real to life situations...AR enables the opportunity to interact with virtual and real

¹² An unforeseen factor that impacted the increase of *off task* as well as *lapses in silence*, was the need for students to walk back to the location where their in-progress quest from the previous session was located. For most teams this was the university SUB (a fair distance from the classrooms), and although some students had access to playable anywhere content, most did not. This would be something to address in future iterations of *Explorez*, and a consideration for others developing place-based gaming environments.

objects together to foster students' learning and motivation" (Tovar et al 2020, p.14). These findings are encouraging and support the potential of the gamified systems as learning environments. Given that the majority of time students remained on task also supports previous research on AR learning environments and their potential to foster student motivation and engagement (Berns et al., 2016; Perry 2015; Tovar et al., 2020).

5.3.3 Lapses, language use and online dictionaries

Other behaviours examined varied greatly between groups and cohorts; such as lapses of silence during gameplay, the amount of English versus French spoken, and use of an online dictionary. Given that AR place-based systems require students to navigate between physical locations, researchers have noted a potential issue of some student teams experiencing large lapses of silence during gameplay (Perry, 2015; J. Sykes, personal communication, June 25, 2018). As Martin et al. (2015) state in regards to designing mobile learning experiences "[i]t takes time to walk from one place to another, and with MML¹³ this should be part of the designed experience" (30). The present research addressed this issue by incorporating strategically placed hidden elements on the map (triggered by location) or timed elements (triggered by amount of time since last encountered game element). The design and implementation of these gaming prompts directly addresses a research gap regarding AR in L2 learning according to Parmaxi and Demetriou (2020):

guidance is regarded as a means to remind stakeholders to communicate with each other and through which learners can become responsible for their learning efforts. This warrants further investigation as to which phases and forms this guidance should be provided and

¹³ MML: Mobile media learning

the development of more tools for underrepresented types of guidance (e.g., prompts and scaffolds) according to the needs of the student. This is an issue that the literature fails to inform us about and is definitely worthy of future investigation.

Natural lapses in conversation are normal, however, for consistency I documented instances of silence that lasted longer than 10 seconds to cohere with Volet et al.'s framework. Findings showed that lapses of silence during gameplay while students walked between locations differed substantially, from as little as zero occurrences for one team to as many as 22 occurrences for another (685 seconds in total representing over 11 minutes of gameplay). Although game design plays a role, other contributing factors would include team cohesion, the student's level of comfort with their teammates, and individual traits such as outgoing and talkative compared to quiet and reserved. Findings suggested that the incorporated design elements of pop-up questions and other game elements assisted in filling potential voids in gameplay.

Furthermore, although some teams had no need for this type of filler, as they visited with teammates while walking between gaming locations, for other teams it appeared to be quite beneficial. An additional emerging benefit of these pop-up elements was their potential to steer students back to the TL when they had been *off task* and engaged in small talk in English.

If an instructor/developer can create a place-based game without significant distances between gameplay locations, lapses in silence are less likely to be an issue. However, when developing a place-based game attempting to incorporate relevant real-life locations, it is more likely that it will at some point require students to cover a fair distance between gaming locations. Strategically placed gaming elements positioned between physical locations or ones set on timers can assist with potential voids and increase interactivity. The majority of L2 place-based AR research thus far examines student interactions at the gameplay locations (e.g. Liu et al., 2016;

Thorne et al., 2021; Zheng et al., 2018); the exception is Thorne et al.'s (2015) study which analyses interaction en route to various locations. Therefore, in order to better understand and continue to improve these learning tools it is worthwhile to also consider and examine what students do while walking between gameplay locations of place-based gaming environments.

The amount of time students remained in the TL during gameplay varied greatly between cohorts and teams. Findings showed that some teams made great efforts regarding language use and employed code switching when lacking vocabulary to express themselves or answer a teammate's question in the TL. However, there were also students who appeared to make little effort and reverted into English/ first language easily. A limitation of this type of mobile system is that the instructor is unaware to what degree the learners remain in the target language. However, in general, this observation applies to any activity outside the classroom (for example, homework). As with any learning scenarios, how much effort a student is willing to put into the task affects the outcome.

The use of an online dictionary also varied significantly between teams and cohorts, some teams chose not to use one at all, while others used an online resource multiple times every session. The Fran 160 students typically used an online dictionary when creating a tweet. In most cases, an online tool was only used after the student asked their teammates if they knew the vocabulary word in the TL. Some students chose not to use an online resource, and instead they modified the content or found an alternative word if no one on their team knew the sought-after word in French. Similarly, the Fran 120 students also used the online resources when creating a tweet for gameplay during *Explorez* (S2 and S3). However, during S1 (*VdeUVic*) these students used the supplied vocabulary sheet to understand the gaming content. What differed between groups was that higher

level French students predominantly used an online dictionary for unknown vocabulary to create a tweet, while lower-level students often used one to look up vocabulary to understand gaming content. As mentioned previously, findings illustrated that the Fran 100 students' expertise in gaming and technology compensated for their lower French language knowledge, and these students progressed as far in *Explorez* as the Fran 120 cohort. This highlights that it is not only students' language abilities that impact their learning experience in these gamified environments, but that other competencies pertaining to technology and gaming also play a role.

Additionally, group cohesion will impact the experience and affect collaborative potential. As Bilgin and Gul (2020) assert, “[g]roup cohesion and attitudes toward group learning environments are important factors that motivate participants to accomplish their assigned tasks collaboratively” (133). The high number of instances of documented laughter (up to 51 times per group per session) suggests group cohesion as well as overall enjoyment. Laughter functions as a means to build social cohesion (Robinson and Smith-Lovin 2001), and positive emotions assist in increasing commitment to the group (Lawler and Yoon, 1993). Moreover, the documented laughter in conjunction with student self-reports on playing in a group further support group cohesion. Most participants reported playing in a group had a positive effect on the experience and that they felt their team worked well together.

5.3.4 Twitter

Findings showed that the integration of Twitter was an effective tool for players to record audio/video journal entries during gameplay. Students used Twitter to document their gameplay and respond to specific tasks, such as answering questions. Tweet types included videos, audio

recordings, pictures and/or text. The Fran 160 students were already using Twitter for class and were therefore already comfortable with the technology. Most teams appeared very engaged in the activities, as observed in the video tweets and data, as well as the group overall posting an average of ~100 tweets per gameplay session. However, some of these students' high production rate was likely motivated by grades since tweets counted as participation points for the Fran 160 course. The Fran 120 students were not using Twitter as a class activity, and tweeted considerably less, which was not unexpected. Especially since most of these students had no previous experience with the microblogging service. Three of the five teams chose not to tweet during *VdeUVic*; however, all teams participated with Twitter for the *Explorez* sessions. Despite the varying degrees of participation, all student teams engaged with Twitter as intended during gameplay, whether they had previously used the tool or not. This supports the Twitter app as an effective addition for gamified systems should the developer require a means for students to respond to questions and tasks, and such a tool is not included in the development platform.

However, participants rated Twitter and the tweeting activities the lowest in regards to learning motivation and usefulness for L2 acquisition. Which raises the question, is Twitter in fact the correct tool choice for gameplay tasks? In Thorne's (2003) study, findings showed that the internet communication tool choice can negatively impact students' interactions. In Thorne's case study 3, the students were asked to communicate via email, which they found unsuitable for age-peer interaction (these students preferred instant messaging for peer interactions), and in result had fewer interactions with their international key-pals. Muller's (2017) research also found that students' attitudes towards technologies impacted their willingness to use them within an educational context. Lightbourn's (2020) case study on using Twitter in a L2 learning context

showed that the students previous L2 education (or lack of), age, learning style and attitude towards technology appeared to influence their level of participation (low to high participation—or no participating at all) and their learning experience with the tool (negative, positive, or average). Similarly, the present research showed that factors such as the level of comfort speaking the L2, learner (and player) styles, and attitude impacted the students learning experience with the tools.

Despite the participants low ratings regarding Twitter’s usefulness for L2 learning, the majority of students responded on the positive end of the spectrum regarding Twitter’s effectiveness for gameplay takes, and most of the students were not dissatisfied in using the tool for the activities. Additionally, the findings illustrated that the majority of high-level co-regulation instances emerged when students collaboratively created tweets as a team in response to tasks and questions from the gaming system. This supports this type of in-game tasks specifically for L2 learners in gaming environments. The findings also corroborate prior research regarding the potential of Twitter for L2 learning (Rosell-Aguilar, 2018). Therefore, in the present research, one could argue that it is not necessarily a case of Twitter being the “wrong tool” but instead highlighting there are improvements to be made and additional research needed.

5.4 Implications of AR in language learning and teaching contexts

AR gamified environments hold significant potential for creating immersive, engaging, and relevant learning experiences for students. Despite the possibility of gamifying an entire course, these experiences are more likely a tool to complement classroom instruction, as was the intention of *Explorez* and *VdeUvic*. Such systems could also be further integrated into course content with pre and post play activities (Holden & Sykes 2011; Sykes et al. 2019).

5.4.1 Developing AR learning environments and experiences

Complex AR projects, such as *Mentira* and *Explorez*, represent a substantial amount of time on gaming design and development which unfortunately is not realistic for the vast majority of instructors. Only individuals passionate about this type of experience for their learners would even be interested in taking on such an endeavor. A major challenge is the very limited availability of AR language learning apps for instructors to use (Khoshnevisan & Le, 2018; Parmaxi & Demetriou 2020). This highlights the importance of sharing such resources. This was the intent in the creation of *Explorez*. Similarly, Nelson's (2018) *Paris Occupé*, is a French role-playing L2 game with several chapters available for instructors to use. *Paris Occupé* is playable anywhere, and therefore an ARIS L2 learning game that is not place-based. However, due to a lack of funding, as of 2020 unfortunately the ARIS platform is no longer supported. It is unclear how long games created within ARIS will continue to function. Field Day labs is in the process of developing another platform for potential use by instructors, but it has been described as more similar to their project Siftr (<https://siftr.org/>) than ARIS, which indicates that it will not include the many features nor flexibility of ARIS. It remains to be seen if gamified systems resembling *Explorez* and *Paris Occupé* will be possible in the alternative platform. Future authors will need to design their systems accordingly or choose a different AR platform.

Nevertheless, this domain continues to expand and therefore there are other AR apps and platforms to explore for creating learning experiences. The complexity of the gamified systems in the present research is also of course not the only option when designing AR learning environments. In a very short time, a simple L2 game or narrative can be developed. For example,

simply by strategically placing a number of AR triggers, students could explore their environment and answer questions or provide information about what they have discovered in the target language. Another option for instructors to consider would be to have their students use an AR platform for content creation. As Holden (2015) states, “AR game creation can be used as a way to integrate the values, methods, and content of a discipline— i.e., if you learn a lot of content while playing a game, you would stand to learn even more by making a game” (80). Parmaxi and Demetriou (2020) note that involving students in the AR creation process can facilitate meaningful learning experiences and offer opportunities for students to become authentic researchers and communicators. Age need not be a barrier, given that AR class projects have been successfully created by a wide range of learners, from elementary students to university students.

5.4.2 Implementing AR learning environments and experiences

Another consideration, even with a tool ready to use, is that the implementation of this types of experience can have additional hurdles/obstacles. As mentioned previously, a main challenge of implementing AR tools within an educational context is students experiencing issues with the usability of the tool, technical problems, and app-related issues (Tovar et al., 2020). It is wise to plan for extra time, as it may be needed for the organizing of teams, extra explanations, dealing with bugs, and/or student accounts. I anticipated the possibility of bugs and such for the first testing session, and therefore as a backup the students were asked to explore the campus in French and tweet about their experience should they encounter technical issues and neither myself nor a TA were nearby to assist. Therefore, even those students that had issues could still stay on task if they

chose to do so. Not an ideal situation, but a consideration if the gamified system is still in its iterative development stages.

Employing AR tools with large groups of students can be very challenging and may not be viable option (Akçayır & Akçayır, 2017). The first session's organization and set-up before gameplay was quite challenging for the large Fran 160 group of 40+ students. However, each consecutive session's set-up improved, and also required less time. Lessons were learned and changes made accordingly to attempt to facilitate the process as much as possible. When students are using their own devices, taking in-class time before the day of gameplay to address downloading the app, creating game accounts, etc. would assist considerably. When supplying students with devices for gameplay, as was the case for cohorts 2 and 3, having the gaming accounts created and devices already logged in is also recommended. The tutorial videos for the ARIS platform and Twitter app also appeared to be beneficial. These would not necessarily need to replace speaking to the class as a whole before gameplay, but the addition of brief video tutorial(s) accessible anytime and also when the students are already in their smaller groups is a worthwhile consideration when students are using new and unfamiliar digital tools.

Finally, BYOD (bring your own device) for team gameplay does require extra consideration and possibly planning. One student's absentee can affect their whole team, if their device was the one the students planned on using. Additionally, requesting students to use their own data, even a small amount, is not ideal. As Tovar et al. (2020) note, technical considerations for AR in education must include accessibility to mobile devices, and internet connection. Gameplay locations with stable and sufficient Wi-Fi is the best possible scenario; however,

supplying students with mobile devices that include data is another option when the prior one is unrealistic.

Parmaxi and Demetriou (2020) note that since AR is a technology that only recently emerged, many instructors may not know about it, while others may be familiar with it, but hesitant to implement AR technology in the language classroom on the account of unease with the usability, convenience, and maintenance of the technology. We most definitely still have challenges to overcome before these types of learning games are easily accessible and implemented for language students; however, as research progresses this goal becomes more attainable.

5.5 Theoretical and methodological contributions

This research also adds to the present body of knowledge with theoretical and methodological contributions. The theoretical contribution of this dissertation was the adaptation of Volet et al.'s (2009) collaborative learning framework for a gaming AR learning context. This framework is a theoretical toolbox for researching gamified AR FL2 environments, as well as other L2 place-based learning games. However, with minimal adaptation it could also be used for research on other place-based games or environments. Similar to the iterative coding development for this research (see section 3.5 *Data analysis*), other researchers could define the relevant categories as they apply to their specific gaming context.

As mentioned previously, Volet et al.'s research entailed the analysis of a scientific clinical case. Despite the very dissimilar learning context of the present research, as seen in section 5.2 *Collaborative learning in gamified AR environments*, the present research findings paralleled many those of Volet et al.'s. This illustrates the potential versatility of the framework for different

learning contexts. The provided details of the steps when developing the codes for analysis (see sections 3.5.3 *Analysis of student gameplay video data for collaborative learning* and 3.5.4 *Analysis of student gameplay video data for learning context*) may therefore also assist others in adapting the framework for other learning contexts. Additionally, Volet et al. chose to only code verbal instances. The addition of the present research employing the framework to also code non-verbal instances of low and high, individual and co-regulation may also be of interest to future research, and merit further investigation. This dissertation not only presents examples of gamified learning-tools in practice, it also offers specific tools to analyse the learners' experiences during gameplay. Moreover, this research contributes a theoretical element to the current limited body of research on using gamified tools in L2 learning.

From a methodological viewpoint as mentioned previously (see section 5.4 *Implications for implementation of AR in language learning and teaching courses/contexts*) the intent had been to share the AR learning tools so that others could adapt these artefacts for their own use with their students or for future research projects. Given that ARIS is no longer being supported (as explained in section 5.4.1) this is of course not possible. However, despite this, the detailed development of the gamified systems (see section 3.1) may help guide others (developers, researchers and/or instructors) in the design process of future gamified learning environments or games. This research also provides an example of how to implement an AR gamified environment in a course setting. The detailed logistics and the lessons learned presented in this dissertation may assist other instructors/researchers with the implementation of learning games or gamified systems.

Additionally, the detailed coding and analysis employing spreadsheets was also an iterative process and may be of interest for future research on collaborative learning (see section 3.5.3).

Volet et al. briefly explain their coding system and inter-judge reliability, but do not indicate what software or program was used to code and analyse the data. Without this information there are not enough details to replicate the study without trial and error on the part of the researcher in order to explore the best way to code and analyse this type of data. Initially I planned to use the data analysis software NVivo. However, several challenges were encountered when sample videos were imported into the software for a trial analysis. After a fair amount of trial and error it became apparent NVivo was not suitable for the proposed analysis, and I began exploring other tools, which resulted in employing spreadsheets for data coding and analysis.

Finally, to the best of my knowledge, using Twitter as a gameplay mechanic in a learning game is also a novel endeavour and may be of interest to others. This dissertation provides examples of Twitter use in a gamified learning context. Twitter use in this fashion can also be very adaptable. Even without an AR gamified tool, language students could be given a simple treasure hunt (electronic or paper form) of places and objects on campus, and then use Twitter to document their progress in the target language.

5.6 Limitations and conclusions

This study has various strengths, limitations, and implications for future research. In regards to strengths, the majority of participants found collaborating with teammates, exploring the campus in the TL, and the place-based aspect of gameplay both motivating and useful for L2 learning. Thus, this study expands on Tang and Taguchi's (2020) research regarding gaming elements that are useful and motivating for L2 learners and contributes to the overall body of knowledge on gameplay for L2 learning. Additionally, observations on the playability of *Explorez*, as well as the

participants feedback on their learning experience with the tool, illustrate its potential to motivate and engage learners. Observations and evaluations also suggest that playing in a group enriched the participants' learning experience, and that the very high level of interactions during gameplay contributed to their language development. Most participants indicated that they enjoyed the opportunity be out of the classroom and found the quests to be relevant. Thus, this study suggests that the tasks and quests help provide a more authentic learning environment through augmented reality. Finally, learners engaged in rewarding and useful activities during their gameplay interactions with each other and *Explorez*.

The findings also support that 'place' played an important role in gameplay, as well as learning, as students drew from their surrounding environment to respond to the tasks at hand. The three emerging themes in regards to the significance of place-based learning in an AR gamified system were: 1) during wayfinding as students figured out the next gameplay location and how to get there, 2) pre-planning discussions before creating a tweet, and 3) both physical and verbal references to the immediate surroundings while answering questions and/or creating a tweet. These results mirror those of Thorne and Hellermann's (2017) study, further supporting the importance of place in AR learning games.

Additionally, the collaborative potential of gamified AR learning systems was apparent. The AR gamified systems provide significant opportunities for CL and high-level co-regulation. Distinct types of learner interactions amongst teams during gameplay are shown. Furthermore, this study identifies patterns in the emergence of learners' high-level co-regulation during collaborative learning, as well as factors contributing to students sustaining engagement of high-level co-regulation episodes. This research also adds to the body of knowledge with the adaptation of Volet

et al.'s (2009) CL framework. This framework was found to be useful in identifying patterns of interaction during gameplay of the AR L2 gamified systems by examining how students socially regulate and process content. Additionally, learner collaboration during gameplay was shown to depend on many factors, including but not limited to the students' themselves, the type of learner/player, group cohesion, and game design.

In regards to limitations, this study includes a small sample size, and therefore does not represent L2 learners as a whole. However, despite the small number of participants, regarding the students' perception of their learning experience, findings support that the students found the L2 gamified systems to be immersive, engaging, and useful. In view of these results, these pedagogical methods merit further study. Another limitation is the lack of a control group; however, the research goal was not to compare classroom learning to gameplay learning. The scope of the present study focused on student collaborative learning within two place-based AR gamified learning environments and sought to identify which gaming elements L2 students found to be useful (or not) for their learning. In addition, this study did not examine French language acquisition nor to what extent the AR systems improved FL2 learning. However, the findings suggest that these tools have this potential. Further research, entailing more iterative development and testing of the gamified AR systems and/or an AR L2 experience with a longer gameplay duration for analysis of the learning experience would undoubtedly provide richer and more diverse results.

Furthermore, this study could have adopted other frameworks of analysis. When this PhD research began in 2015, there were no known studies exploring collaborative learning in AR L2 gamified environments. However, since then such studies have begun to emerge (see Berns et al.,

2016; Hellermann et al. 2017; Thorne & Hellermann, 2017; Sydorenko et al., 2019; Zheng et al., 2018 in section 2.5). Therefore, by drawing on sociocultural theory and conversation analysis, the present research could have employed Sydorenko et al.'s (2019) approach, which examines language learning in a mobile AR game by the analysis of language-related episodes (LREs; Swain & Lapkin, 1998). Sydorenko et al.'s framework explores the microgenesis of learners' comprehension and ensuing usage of varied lexical items. As Sydorenko et al. highlight, some tasks (including gaming) "can facilitate participants' involvement in the co-construction of meaning, problem solving, and knowledge building through talk" (717). Swain and Watanabe (2013) define such talk as *collaborative dialogue*: "dialogue in which speakers are engaged in problem solving and knowledge building. ... [D]uring collaborative dialogue, one or both speakers may refine their knowledge or come to a new or deeper understanding of a phenomenon" (1). LREs are proposed as catalysts for learning when engaging in collaborative dialogue (Sydorenko et al., 2019). According to Swain and Lapkin (1998) LREs are "any part of the dialogue where the students talk about the language they are producing, question their language use, or correct themselves or others" (326). Such LREs and collaborative dialogue were repeatedly documented when coding the video data. Therefore, exploring participants collaborative dialogue during gameplay, with a close analysis of LREs would be another promising avenue of research.

This study has several implications for future research. This research focused on the impact of AR gamified technologies on language learning. This innovative field of research aims to create learning environments that are personalized, social in nature, and extend beyond the classroom. Although this study explores the potential of AR gamified learning tools specifically in the context of FL2, the research findings are valid for any L2 pedagogy. Additionally, as mentioned

previously, the proposed adapted framework of Volet et al. (2009) is not limited to L2 learning and could be modified and applied to other learning contexts for future research.

Also worth noting is that although approximately two thirds of the participants could not see the value in the tweeting tasks, the emergence of high-level co-regulation instances while students worked together to complete these tasks support these types of activities in a gamified environment. Additionally, the integration of Twitter was an effective tool for players to record audio/video journal entries during gameplay. Therefore, further research on AR gamified design, as well as gaming elements to specific learning contexts, such as employing Twitter for gameplay tasks, merit consideration.

Another viable option is also exploring other social media tools. In the present research, in the pre-questionnaire, when the participants were asked about their frequency of social media use, all three cohorts responded that they used Twitter the least and Instagram the most. Since Instagram allows video recordings and images, this online tool could be used for gameplay tasks. Further research could explore if using an online tool more prevalently used by students increases the frequency of use during gameplay and therefore potentially increases learner interactions and collaboration.

As Sydorenko et al. (2019) note, research remains limited on the value of place-based mobile applications for language learning. This research seeks to highlight advantages and limitations of collaborative mobile AR gamified environments for L2 learning, but in no way implies that the use of gamified systems will revolutionize L2 teaching and learning. However, this research has shown that the use of AR FL2 gameplay provides clear advantages, and that

continued research on AR place-based learning games is needed in order to contribute to developing immersive, engaging and contextual learning environments.

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Appendices

Appendix A Pre-questionnaire

Consent form before starting Questionnaire

Dear participants,

As explained to you by Ms Bernadette Perry, this first questionnaire is part of a PhD SSHRC funded research (767-2015-1050) project under the supervision of Dr. Daniela Damian (professor of computer science) and Dr. Catherine Caws (professor of French), at the University of Victoria, Canada.

The purpose of the research is to explore the benefits and limitations of gamifying language learning via mobile augmented realities (AR), focusing on collaborative learning. The research objective is to investigate the interactions of the students with the AR learning-tools, and with teammates, in order to ascertain which elements of the tools are correlated with effective collaborative learning.

You are receiving this questionnaire because you signed a consent form in class allowing Ms. Perry to contact you in order to collect data through questionnaires (one pre-questionnaire and one post-questionnaire) and possibly a focus group discussion.

This first questionnaire will take between 5 and 8 minutes of your personal time. As explained during the presentation in class, we are mandated to remind you that your participation is completely voluntary.

The main benefit of participating is that you are contributing to the pursuit of knowledge. There are no known or anticipated risks to you by participating in this research.

Should you have any questions or worries about this research, please contact either Bernadette Perry (bernadet@uvic.ca), Dr. Daniela Damian (danielad@uvic.ca) or Dr. Catherine Caws (ccaws@uvi.ca).

* By completing and submitting the questionnaire, YOUR FREE AND INFORMED CONSENT IS IMPLIED and indicates that you understand the above conditions of participation in this study.

I wish to fill out the questionnaire and thus consent to the research

I do not consent to the research

Questionnaire 1

This first questionnaire contains 22 questions. It will take between 5-8 minutes to finish. Please take the time to read the questions carefully and to answer them as best as you can. Thank you for taking part in this study. Merci beaucoup!

* 1. What are the last 4 digits of your student ID number (for research purposes to link data & responses between survey 1 to survey 2).

* 2. On a scale of 1 to 6, how **experienced** are you with the following games (1 = none-never played 6 = very experienced).

	1 None-never played one	2	3	4	5	6 Very experienced
Board games	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Single player computer/console games	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Multi player computer/console games (online or in person)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Massively multiplayer online gaming (such as World of Warcraft, Runescape, etc.)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Mobile games (such as PokemonGo, Clash of Titans, Candy Crush, etc.)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

* 3. What is your **attitude** towards video games?

- | | |
|-----------------------------------------|-----------------------------------------|
| <input type="radio"/> Strongly Negative | <input type="radio"/> Slightly positive |
| <input type="radio"/> Negative | <input type="radio"/> Positive |
| <input type="radio"/> Slightly negative | <input type="radio"/> Very Positive |

* 4. How much do you like playing **board games**?

- | | |
|-----------------------------------|----------------------------------|
| <input type="radio"/> Very much | <input type="radio"/> Not really |
| <input type="radio"/> Quite a lot | <input type="radio"/> Not at all |
| <input type="radio"/> So-so | |

* 5. How much do you like playing **video games**?

- | | |
|-----------------------------------|----------------------------------|
| <input type="radio"/> Very much | <input type="radio"/> Not really |
| <input type="radio"/> Quite a lot | <input type="radio"/> Not at all |
| <input type="radio"/> So-so | |

* 11. How much do you **agree** with each of the following statements in regards to **collaborative tasks** for **language learning**.

	Strongly disagree	Disagree	Slightly disagree	Slightly agree	Agree	Strongly agree
helps understanding/comprehension	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
creates a more relaxed atmosphere	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
allows for useful/helpful feedback	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
is more work – for myself and the group	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
encourages advanced students to help other students	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
enhances communication skills	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

* 12. How much do you **agree** with each of the following statements in regards to **collaborative tasks** for **language learning**.

	Strongly disagree	Disagree	Slightly disagree	Slightly agree	Agree	Strongly agree
allow learners to actively participate in their learning	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
are fun	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
foster team spirit	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
are a waste of time (always explaining things to others)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
difficult getting members to participate in tasks	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
(collaborative tasks) should be encouraged/continued	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

* 13. On a scale of 1 to 6, how experienced are you with the following technologies (1= not experienced at all 6= very experienced)

	1 (no experience)	2	3	4	5	6 (very experienced)
Social networking (such as Facebook, Twitter, Snapchat, Instagram)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Educational apps (such as WordRef, Duolingo, Dictionaries, Bon Patron, Linguee,	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Reading news, articles or books online	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Cloud computing (Dropbox, Google Drive, etc.)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Audio or video sites or apps (Youtube, Spotify, Itunes, etc)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

* 14. How many hours per **week** do you spend on **average** on the internet or technology-mediated activities for **personal use** ?

- 0-2 hours
 10 to 15 hours
 2-5 hours
 more than 15 hours
 5-10 hours

* 15. How many hours per **week** do you spend on **average** on the internet or technology-mediated activities for **studying or university work**?

- 0-2 hours
 10 to 15 hours
 2-5 hours
 more than 15 hours
 5-10 hours

* 16. How often do you use the following social networking sites? (1= not at all, 6= very often)

	1 (not at all)	2	3	4	5	6 (very often)
Twitter	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Facebook	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Instagram	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Messaging apps (Telegram, WhatsApp, etc.)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Snapchat	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Skype or Facetime	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

* 17. Do you use a mobile device (or several devices) on a regular basis?

Yes

No

If Yes, please tell us what device you use (such as Iphone6s, iPhone7, Samsung, Ipad2, iPad Pro, etc)

* 18. On a scale of 1 to 6, can you rate your attitude towards using technology for learning ? (i.e. how do you feel about having to use social media, icloud computing, mobile applications etc. in your courses or for studying) (1= Strongly negative, and 6= Strongly positive)

1 (strongly negative)

4

2

5

3

6 (strongly positive)

* 19. What kind of activities motivate you to learn? (Check all that apply)

- | | |
|--------------------------------------------------------|----------------------------------------------------------------------------------------------------------|
| <input type="checkbox"/> Group activities in class | <input type="checkbox"/> Practice exercises (fill-in-the blank, comprehension questions, etc.) |
| <input type="checkbox"/> Individual work in class | <input type="checkbox"/> Reading |
| <input type="checkbox"/> Tests | <input type="checkbox"/> Writing |
| <input type="checkbox"/> Individual projects | <input type="checkbox"/> Using learning-technologies (social media, icloud computing, mobile apps, etc.) |
| <input type="checkbox"/> Group projects | <input type="checkbox"/> Oral practice (discussion, debate, etc.) |
| <input type="checkbox"/> Individual oral presentations | <input type="checkbox"/> Lectures |
| <input type="checkbox"/> Group oral presentations | <input type="checkbox"/> Watching videos |
| <input type="checkbox"/> Other (please specify) | |

* 20. What is your background in French?

- French as second language (FSL)
- Immersion
- Programme cadre
- Francophone school
- Other (please specify)

* 21. What is your native language?

- English
- French
- Other (please specify)

* 22. What is your age?

- | | |
|-----------------------------|-------------------------------|
| <input type="radio"/> 17-21 | <input type="radio"/> 36-40 |
| <input type="radio"/> 22-25 | <input type="radio"/> 41-50 |
| <input type="radio"/> 26-30 | <input type="radio"/> over 50 |
| <input type="radio"/> 30-35 | |

Appendix B Post-questionnaire

Consent form before starting Questionnaire

Dear participants,

As explained to you by Ms Bernadette Perry, this second questionnaire is part of a PhD SSHRC funded research (767-2015-1050) project under the supervision of Dr. Daniela Damian (professor of computer science) and Dr. Catherine Caws (professor of French), at the University of Victoria, Canada.

The purpose of the research is to explore the benefits and limitations of gamifying language learning via mobile augmented realities (AR), focusing on collaborative learning. The research objective is to investigate the interactions of the students with the AR learning-tools, and with teammates, in order to ascertain which elements of the tools are correlated with effective collaborative learning.

You are receiving this questionnaire because you signed a consent form in class allowing Ms. Perry to contact you in order to collect data through questionnaires (one pre and one post-questionnaire) and possibly a focus group discussion.

This questionnaire will take between 6 and 8 minutes of your time. As explained during the presentation in class, we are mandated to remind you that your participation is completely voluntary.

The main benefit of participating is that you are contributing to the pursuit of knowledge. There are no known or anticipated risks to you by participating in this research.

Should you have any questions or worries about this research, please contact either Bernadette Perry (bernadet@uvic.ca), Dr. Daniela Damian (danielad@uvic.ca) or Dr. Catherine Caws (ccaws@uvi.ca).

* By completing and submitting the questionnaire, YOUR FREE AND INFORMED CONSENT IS IMPLIED and indicates that you understand the above conditions of participation in this study.

- I wish to fill out the questionnaire and thus consent to the research
- I do not consent to the research

* 1. What is your identification number (for research purposes). Please use the code that you received at the beginning of the study

* 2. What **motivated** you to volunteer **to participate** in the research? Check all that apply:

interest in augmented reality

interest in a gamified language tool

interest in games

opportunity to learn French outside of the classroom

interest in student research

opportunity to engage in an activity different than those of regular class

Other (please specify)

* 3. What do you think the effect of **gamified tools** is **in general** on students' **motivation** for language learning?

very motivating

motivating

neutral

demotivating

very demotivating

* 4. How would you describe your **experience** with the **1st game Visite de UVic**? Please check all that apply.

motivating

useless

demotivating

fun

relevant

boring

irrelevant

interactive

useful

other (please specify)

* 5. How would you describe your **experience** with the **2nd game Explorez**? Please check all that apply.

- | | |
|-------------------------------------------------|--------------------------------------|
| <input type="checkbox"/> motivating | <input type="checkbox"/> useless |
| <input type="checkbox"/> demotivating | <input type="checkbox"/> fun |
| <input type="checkbox"/> relevant | <input type="checkbox"/> boring |
| <input type="checkbox"/> irrelevant | <input type="checkbox"/> interactive |
| <input type="checkbox"/> useful | |
| <input type="checkbox"/> Other (please specify) | |

* 6. Please rate your **overall experience**:

	N/A	1 = very poor	2 = poor	3 = acceptable	4 = good	5 = very good
1st game session- Visite de UVic	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
2nd game session- Explorez	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3rd game session- Explorez	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

* 7. Please **rate** the following as a **French language activity**: 1=useless 5=very useful

	1 = useless	2 = mostly useless	3 = neutral	4 = useful	5 = very useful
Visite de Uvic game	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Explorez	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Using Twitter to post game content and pictures/videos	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

* 8. Which elements in the 2nd game *Explorez* do you feel are **useful** for **French language learning**? Please check all that apply:

- | | |
|------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|
| <input type="checkbox"/> treasure hunt aspect/exploring the campus in French | <input type="checkbox"/> interacting with game content (characters, videos, objects) |
| <input type="checkbox"/> completing quests | <input type="checkbox"/> tweeting game content and recordings |
| <input type="checkbox"/> collaborating with teammates | <input type="checkbox"/> none of the elements are useful for language learning |
| <input type="checkbox"/> narrative | |
| <input type="checkbox"/> Other (please specify) | |

* 9. Did you experience any difficulties during the game sessions? Such as tech issues, comprehension, Twitter com crashing in 1st game, etc.

- No
- Yes (please briefly explain & specify for which game(s) - VdeUVic and/or Explorez)

* 10. During the **1st game Visite de UVic** Twitter was used to post game progress and communicate with other players. **Other than technical issues** experienced, how **effective** was Twitter for this task?

- Extremely effective
- Very effective
- Somewhat effective
- Not so effective
- Not at all effective

* 11. The game *Explorez* had tasks which required players to make recordings (to practice your oral French). How do you feel about the use of Twitter for these tasks?

- Very satisfied
- Satisfied
- Neither satisfied nor dissatisfied
- Dissatisfied
- Very dissatisfied

* 12. Rate the following as **learning motivators** in regards to your experience with **Explorez**

	1= negative - it was demotivating	2 = mildly negative - it was a distraction	3 = none - it made no difference	4 = mildly positive- it encouraged me in my learning	5= positive — it motivated me in my learning
Treasure hunt aspect- exploring the campus	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Completing quests	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Collecting badges	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Collaborating with teammates	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Interacting with game content- characters, videos, objects	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Tweeting recordings & game content	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

* 13. In comparison to your regular language labs, do you feel your engagement with the French language (your use of French) during the experiment was:

- less
- slightly less
- the same
- slightly more
- more

* 14. On a scale from 1 (very uncomfortable) to 5 (very comfortable), how **comfortable** did you feel speaking French:

	1 = very uncomfortable	2 = uncomfortable	3 = neither	4 = comfortable	5 = very comfortable
During your French language lab(s)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
During your French class(es)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
During gameplay of <i>Visite de UVic</i> and <i>Explorez</i>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

* 15. What was your **experience** playing *Visite de UVic & Explorez* in a **group**?

- It had a very negative effect on the experience
- It had a negative effect on the experience
- It had a no effect on the experience
- It had a positive effect on the experience
- It had a very positive effect on the experience

* 16. In your opinion how did your team work together during gameplay?

- not very well at all
- not well
- okay
- well
- very well

* 17. How much do you **agree** with each of the following statements in regards to **collaborative tasks** during the **Visite de UVic & Explorez** games played in class.

	Strongly disagree	Disagree	Slightly disagree	Slightly agree	Agree	Strongly agree
helps understanding/comprehension	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
creates a more relaxed atmosphere	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
allows for useful/helpful feedback	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
is more work - for myself and the group	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
encourages advanced students to help other students	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
enhances communication skills	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

* 18. How much do you **agree** with each of the following statements in regards to **collaborative tasks** during the **Visite de UVic & Explorez** games played in class.

	Strongly disagree	Disagree	Slightly disagree	Slightly agree	Agree	Strongly agree
allow learners to actively participate in their learning	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
are fun	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
foster team spirit	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
are a waste of time (always explaining things to others)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
difficult getting members to actively participate in tasks	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
collaborative tasks should be encouraged/continued	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

* 19. Can I contact you in the New Year for a brief interview? In exchange for your time, I will compensate you with a \$10 UVic Onecard. The interview will last between 10-15 mins. Thanks for completing the survey!

Yes, you may contact me via email

No, you may not contact me

20. Please include any additional questions or comments below.

Appendix C Interview questions

1. What was your first impression when using the gamified tools / games?
2. What constraints / issues did you have using the tool?
3. What would you like to see or add in the tools you used in order to make it more user-friendly? Any suggestions to make it more user-friendly
4. What would you like to see or add in the tool more conducive to collaboration? In other words, make it more helpful / likely for you & your teammates to collaborate
5. a) Did “place” add to the learning experience? In other words, did being outside of the classroom, in real environments (although only virtually francophone) add to your learning experience? Or aid in making your learning more relevant / meaningful? In what way?

b) Did you learn about a location (French lib or help centre or maybe if you went to the gardens maybe you’d never been there before?)
6. a) Considering your prior experiences of collaborative learning, what, if any, were the learning benefits of playing the games with teammates in comparison to playing alone?

b) What, if any, were the social benefits?
7. What worked well – what would you say are strengths if the game(s) what did you like? and why?
8. What didn’t work well? What if anything would change and/or remove? What didn’t you like & why?
9. a) How did you feel about the audio or video recordings to twitter?

b) Would a twitter game account have made feel more comfortable posting?

c) Were there too many recordings? Was this too complicated?

d) Should I have had the option of either text OR voice? In case locations players feel uncomfortable?
10. Do you have anything to add? Any questions or comments?

Appendix D Explorez 2.0 Quest details

To begin gameplay, a player creates a user account, logs into the ARIS app, and from the game list chooses “*Explorez 2.0*”. After viewing the introduction plaque (which says “[d]éveloppez vos compétences linguistiques en français, tout en explorant le campus de l’Université de Victoria”) the ARIS gameplay tutorial automatically pops up for students to view. Next, the NPC Sophie welcomes players and asks for assistance, explaining that a francophone celebrity is visiting the campus. This is a branching conversation, giving the player options when responding to her questions, though at this stage it is more of an illusion of gameplay options, as eventually every player will either end up at the first task or if they choose not to help, Sophie thanks them for their time and the game exits to the map. The first task entails players introducing themselves to the celebrity, and a droid looking NPC named IA (artificial intelligence in French) pops up and breaks the fourth wall in order to explain how to do so, first giving instructions and then guiding players to the Twitter tutorial. IA also informs the players that he will appear with hints and information throughout gameplay. Once players have successfully completed the first task, they are instructed to click on the “On y va” plaque on the map which reads: “[v]otre première mission est d’aller chercher Pierre et Bernadette. Ils travaillent pour la personnalité qui visite notre campus et ils vont vous donner des instructions. Pierre vous attend près du Quad. Bernadette vous attend devant la fontaine.” When players close this window, the first two quests are triggered and appear on the screen as follows: Quête 1 “Trouver Bernadette” which states “[a]llez chercher Bernadette. Elle vous attend devant la fontaine” and Quête 2 “Trouver Pierre” which indicates “[a]llez chercher Pierre. Il vous attend près du QUAD”. *Explorez* consists of twelve quests and each quest includes the following elements:

- the level of the quest, the title, and the opening text (**start**)
- the closing text (**end**)
- what the player must have done or picked up in their inventory in order for the quest to be triggered (**prerequisite to start**)
- what the player must have done or picked up in their inventory in order for the quest to be completed (**requirement for quest completion**)
- what the player must have done to earn the badge for the quest (**badge requirements**)
- XP experience points given for quest completion (**events-player modifier**)
- the **dialogues** of the characters associated with each quest

Level 1 Quest 1: Trouver Pierre

Start: Allez chercher Pierre. Il vous attend près du QUAD.

End: Bravo ! Vous avez trouvé Pierre. Continuez !

Prerequisite to start: player has viewed plaque *Première mission*

Quest completion requirements: player has exited conversation *Pierre*

Badge requirements: player has exited conversation *Pierre*¹⁴

Events-player modifier: 50 XP

Dialogue: n.a.

Level 1 Quest 2: Trouver Bernadette

Start: Allez chercher Bernadette. Elle vous attend devant la fontaine.

End: Très bien ! Vous avez trouvé Bernadette. Continuez !

Prerequisite to start: player has viewed plaque *Première mission*

Quest completion requirements: player has exited conversation *Bernadette*

Badge requirements: player has exited conversation *Bernadette*

Events-player modifier: 50 XP

Dialogue: n.a.

Level 1 Quest 3: Trouver le bon café

Start: La personnalité veut boire du café. Allez chercher un café americano et apportez-le à

¹⁴ The same gameplay event can trigger both quest completion and badge access

Bernadette.

End: Félicitations ! Vous avez trouvé le bon café, la personnalité le trouve délicieux. Enregistrez une entrée dans votre journal audio. Quel type de café aimez-vous ?

Prerequisite to start: player has the badge “Trouver Bernadette” in their inventory

Quest completion requirements: player has the correct object in their inventory (un café américain), and has “ordered” the coffee in French (by means of an audio journal entry).

Badge requirements: player has completed quest “Trouver le bon café”

Events-player modifier: 150 XP

Dialogue: NPC Bernadette (each quest has a main NPC associated with it; however, dependant on quest location players will also interact with NPCs they have previously met during gameplay).

Bernadette: Pardonnez-moi. Notre patron (la personnalité) veut du café. Est-ce que vous pouvez m'aider?

Player (option 1): Oui !

Bernadette: Choisissez l'un des trois cafés sur la carte et apportez-le-moi. Enregistrez votre commande dans votre journal audio.

Player (option 2): Peut-être?...

Player: Merci, mais on est en train de faire une autre tâche en ce moment.

Continue

Bernadette: Ah d'accord...mais, si vous changez d'avis, allez choisir l'un des trois cafés sur la carte et apportez-le-moi.

Continue

Bernadette: Ensuite, enregistrez votre commande dans votre journal audio. Revenez si vous changez d'avis. Adieu !

After meeting both Pierre and Bernadette, the NPC IA is triggered and asks the players which quest they would like to pursue. If the player chooses the coffee quest, three coffees at different locations appear on the map (as seen in Figure 2). However, only one location has the coffee the celebrity has requested. If the incorrect coffee is picked up, the NPC Bernadette responds as follows:

- a. Ce n'est pas du bon café. Allez chercher un café américain au SUB. La machine à expresso ne fonctionne pas ici.
- b. Ce n'est pas du bon café. Allez chercher un café américain au Munchie Bar.

When the player has the correct coffee (the object “un café americano”) in their inventory, the NPC IA is triggered and reminds the player to now make an audio recording ordering the coffee in French in order to complete the quest. IA also tells the player to use the AR function on the Munchie Bar sign once they have made their recording, which triggers the system requirement for quest completion. Bernadette then responds with “Merci de m’ avoir apporté le bon café.”

Level 1 Quest 4: Trouver un livre

Start: La personnalité aimerait lire quelque chose de divertissant. Trouver « Les Misérables » de Victor Hugo à la bibliothèque.

End: Très bien fait! Enregistrez une entrée dans votre journal audio. Que pensez-vous de ce livre ? Avez-vous d’autres suggestions ? Pourquoi ?

Prerequisite to start: player has the badge “Trouver Pierre” in their inventory

Quest completion requirements: player has given the object “un livre” to Pierre and made an audio journal entry about *Les Misérables* or their favourite book

Badge requirements: player has completed the quest “Trouver un livre”

Events-player modifier: 150 XP

Dialogue: Pierre

Pierre: Bonjour ! Je m’appelle Pierre. Votre patron aimerait lire quelque chose de divertissant. Trouvez « Les Misérables » à la bibliothèque.

Continue

Ou bien vous pouvez recommander quelque chose d'autre. N’oubliez pas d’enregistrer une entrée pour votre journal audio !

This quest also includes another conversation with Pierre in which he provides instructions on how to find the book using the library website, as well as explaining to students how to receive a text with the call number of the book and access the map of the library in order to view where the book is located. Gameplay hints are also timed to pop up if it takes a player longer than 5 minutes to locate the correct book in the library. Once the students use the AR tab on the correct books in the French section of the library, a virtual book drops onto the map, which they take to Pierre to complete his quest.

Pierre: Merci de m'avoir apporté le livre ! Très bien ! C'est le livre préféré de notre patron.

Continue

Enregistrez une entrée dans votre journal audio. Que pensez-vous de ce livre (ou peut-être vous avez vu le film) ?

Continue

Si vous ne connaissez pas cette histoire, pas de problème. La célébrité veut aussi savoir quel est ton livre préféré.

Continue

Revenez me voir après avoir fait votre enregistrement.

Level 2 Quest 5: Le cinéma

Start: 1. Regardez les trois bandes annonces. 2. Enregistrez une entrée qui indique quel film vous aimez voir. 3. Utilisez votre onglet RA sur le panneau Munchie bar.

End: Excellent ! Continuez !

Prerequisite to start: player has the badge “Trouver le bon café” in their inventory

Quest completion requirements: player has viewed all three movie trailers and made an audio journal entry briefly explaining the films, as well as which one they would recommend and why

Badge requirements: player has completed the quest “Le cinéma”

Events-player modifier: 250 XP

Dialogue: Fiona

Fiona: Bonjour ! Notre patron (la célébrité) veut savoir quels films français sont à l'affiche au Cinecenta.

Continue

IA: 1. Regardez les trois bandes annonces (elles sont maintenant visibles sur la carte)
2. Enregistrez une entrée dans votre journal audio. Expliquez un peu chaque film (le titre, le genre, l'intrigue), puis dites lequel vous recommanderiez (et pourquoi).

Continue

3. Utilisez votre onglet RA sur l'enseigne de Munchie bar (*image of sign provided for player*).

Level 2 Quest 6: Le SUB

Start: Faites un enregistrement qui indique quels services se trouvent au SUB. Indiquez-en au moins trois s'il vous plait.

End: Excellent ! Continuez !

Prerequisite to start: player has viewed one of two conversation lines from branching conversation offering the option of *Quête le SUB* (“Le cinéma” is an optional quest and therefore is not triggered by this badge)

Quest completion requirements: player has made an audio journal entry indicating three services available in the SUB

Badge requirements: player has completed the quest “Le SUB”

Events-player modifier: 250 XP

Dialogue: Fiona

Fiona: Découvrez les services qui sont offerts ici au SUB. Je crois qu'il y a plusieurs établissements de restauration, un pub et une agence de voyages.

Continue

La station de radio du campus se trouve ici aussi, n'est-ce pas ?

Continue

IA: Allez voir, puis faites un enregistrement qui indique quels services se trouvent ici au SUB. Indiquez-en au moins trois s'il vous plait.

Continue

Ensuite, utilisez l'onglet RA sur l'enseigne UVSS (*image of sign provided for player*).

Level 2 Quest 7: Mystic Market

Start: C'est à vous de commander quelque chose à manger pour notre patron. Commandez-lui une entrée, un plat principal et un dessert.

End: Excellent ! Continuez !

Prerequisite to start: player has viewed one of two conversation lines from branching conversations offering the option of *Quête Mystic Market* ("Le SUB" is an optional quest and players may have completed it and/or the quest "Trouver des services en français", therefore "Mystic Market" is not triggered by a badge)

Quest completion requirements: player has made an audio journal entry ordering an appetizer, a main course and a dessert

Badge requirements: player has completed the quest "Mystic Market"

Events-player modifier: 250 XP

Dialogue: Jack

Jack: Salut ! C'est à vous de commander quelque chose à manger pour notre patron.

Continue

Le Mystic Market propose 8 kiosques alimentaires uniques qui offrent une gamme variée de plats ainsi qu'une supérette.

Continue

Notre patron aime les plats épicés. Commandez-lui une entrée, un plat principal et un dessert.

Continue

Après avoir commandé son repas. Rejoignez-moi à l'enseigne de Mystic Market. C'est juste en face des toilettes.

Continue

IA: Quand vous y arrivez, utilisez votre onglet RA sur l'enseigne de Mystic Market (*image of sign provided for player*)

Continue

N'oubliez pas de faire un enregistrement quand vous commandez la nourriture.

Level 2 Quest 8: Trouver des services en français

Start: La personnalité veut savoir quelles ressources françaises sont disponibles pour les étudiants de cette université. Trouvez le centre d'aide francophone, le bureau du département de français et la bibliothèque du département. Prenez une photo de chaque endroit visité.

End: La personnalité vous remercie pour votre aide ! Enregistrez une entrée dans votre journal audio. Indiquez où se trouve chaque service (le bâtiment, la salle). En plus, indiquez un ou deux services offerts par ces endroits.

Prerequisite to start: player has seen a conversation line or exited a conversation with the option of *Quête Trouver des services en français* (this quest is accessible from four different previous quests: Trouver un livre, Le cinéma, Le SUB or Mystic Market; therefore it has four different triggers to access it)

Quest completion requirements: player has created three audio journal entries, one for each location visited, explaining what the service offers and where it is available

Badge requirements: player has completed the quest “Trouver des services en français”

Events-player modifier: 250 XP

Dialogue: Pierre/Louis

Pierre: Maintenant, la personnalité veut savoir quelles ressources françaises sont disponibles pour les étudiants de cette université.

Continue

Trouvez le centre d'aide francophone, le bureau du département de français et la bibliothèque du département. Prenez une photo de chaque endroit visité.

Continue

Si vous ne savez pas où se trouvent ces endroits, Louis vous attend près de la fontaine et il peut vous indiquer la direction.

Louis: Salut ! Les services en français ? Oui, je peux vous dire où ils se trouvent.

Continue

Le bureau du département de français est dans Clearihue (CLE) C247 et la bibliothèque du département est dans CLE C253. Le centre d'aide francophone se situe dans CLE C243.

The above conversation is seen if the player has just completed the “Trouver un livre” quest. A copy of the above conversation, this time with Louis supplying all the information (and edited accordingly), is accessed if the player has just completed the quests “Le cinéma”, “Le SUB” or “Mystic Market”.

Level 3 Quest 9: Se détendre

Start: La personnalité se sent stressée. Aidez-la à trouver un lieu tranquille pour se détendre. Visitez Cinecenta, Mac's et les jardins Finnerty. Lequel de ces endroits préférez-vous ?

End: Bravo ! Votre patron est très content de ce lieu. Enregistrez une entrée dans votre journal audio. Aimez-vous ce lieu, ou avez-vous une autre préférence ? Expliquez pourquoi.

Prerequisite to start: player has exited one of two conversations offering the quest “Se détendre” as a next quest option

Quest completion requirements: player has created an audio journal entry at Finnerty gardens explaining which location they feel is the best to relax and take a break on campus.

Badge requirements: player has completed the quest “Se détendre”

Events-player modifier: 500 XP

Dialogue: Jack

Jack: Maintenant, notre patron m’a dit qu’il se sentait stressé. Aidez-le à trouver un lieu tranquille pour se détendre. Visitez Cinecenta, Mac’s et les jardins Finnerty.

Continue

Player: Nous sommes déjà allés au Cinecenta.

Continue

Jack: D'accord. Donc, allez au Mac's pour rencontrer Sophie. Elle vous dirigera vers les jardins. Puis dites-nous lequel de ces endroits vous préférez pour vous détendre.

Continue

Jack: Ou vous pouvez visiter trois villes francophones.

Continue

IA: WARNING! The Quest *Se détendre* requires you to physically walk to Mac's and then UVic Gardens!

Continue

IA: If the weather is awful & you're not up for a walk I suggest you take the other option!

Player (option 1): We're up for a walk! Nous allons au Mac's

Allons au bâtiment MacLaurin pour rencontrer Sophie !

Player (option 2): L'autre option svp

Voyagez !

The above conversation is seen if the player has just completed the “Mystic Market” quest. A copy of the above conversation, this time with Louis, is accessed if the player has just completed the quest “Trouver des services en français”.

Level 3 Quest 10: Le Mystère du sac à main

Start: Super ! Vous avez découvert un sac à main plein d’argent, mais sans carte d’identité ! Cherchez des indices pour pouvoir le rendre à sa propriétaire. Peut-être qu'elle vous remboursera.

End: Félicitations! Vous avez reçu une promotion! Maintenant vous allez devoir travailler dur, mais vous serez bien payé! Enregistrez une entrée dans votre journal audio. Décrivez comment vous avez réussi à en arriver jusque-là.

Prerequisite to start: player has the item “un sac à main” in their inventory

Quest completion requirements: player has returned the items “un sac à main”, “un collier” and “une photo” to Chantelle and made an audio journal entry

Badge requirements: player has completed quest “Le mystère du sac à main”

Events-player modifier: 500 XP

Dialogue: IA/Chantelle

IA: Waooo! Vous avez découvert un sac à main plein d'argent, mais sans carte d'identité !
Continue

Cherchez des indices pour pouvoir le rendre à son/sa propriétaire. Peut-être qu'il/elle vous récompensera.

Chantelle: Merci beaucoup. Je vous suis très reconnaissante de m'avoir rapporté mon collier et mon sac à main !

Continue

Voici un cadeau ! Et des billets de concert.

Continue

J'espère que vous apprécierez le concert !

Level 3 Quest 11: Critique de musique

Start: Votre patron veut savoir quel spectacle du festival mérite son attention. Créez une note audio qui décrit l'une des chansons que vous avez aimée.

End: Enregistrez une entrée dans votre journal audio. Critiquez l'une des vidéos.

Prerequisite to start: player has exited one of three conversations offering the quest "Critique de musique" as a next quest option

Quest completion requirements: player has made an audio journal entry critiquing one of the songs or has interviewed one of their teammates

Badge requirements: player completed the quest "Critique de musique"

Events-player modifier: 500 XP

Dialogue: Chantelle

Chantelle: Votre patron veut savoir quel spectacle du festival de musique mérite son attention. *Continue*

Écoutez au moins 3 chansons du festival. Ensuite, enregistrez une entrée dans votre journal audio qui décrit l'une des chansons que vous avez aimé(e)s.

Continue

IA: This Quest can be achieved from anywhere on campus. Simply click on the music note icons at UVic's Phoenix Theatre to access the music. Please note, these music videos may take 15-30 seconds to load. Thanks for your patience!

Continue

Mais si vous décidez d'aller physiquement au théâtre Phoenix, il y aura des points bonus pour votre équipe !

Level 3 Quest 12: Voyagez !

Start: Votre travail exige que vous voyagez. Vous visiterez au moins trois villes francophones.

Vous allez rencontrer quelqu'un de différent dans chaque région. (Indice : regardez au moins trois des vidéos indiquées sur la carte par leur drapeau respectif. Ensuite, créez un enregistrement vocal et indiquez où vous avez voyagé).

End: La personnalité espère que vous avez fait bon séjour et elle veut en savoir plus !

Enregistrez une entrée : où êtes-vous allé(e), qui avez-vous rencontré ? En plus, donnez au moins trois informations à propos de la personne que vous avez rencontrée.

Prerequisite to start: player has exited one of two conversations offering the quest “Voyagez” as a next quest option

Quest completion requirements: player has made an audio journal entry detailing three of the locations visited, as well as who they met

Badge requirements: player has completed the quest “Voyagez”

Events-player modifier: 500 XP

Dialogue: Magali

Magali: Bonjour ! Votre travail exige que vous voyagiez. Vous visiterez au moins trois autres villes francophones. Vous allez rencontrer une personne différente dans chaque région.

Continue

AI: Indice: regardez au moins 3 des vidéos indiquées sur la carte (au QUAD) par leur drapeau respectif.

Continue

Ensuite, enregistrez une entrée: où êtes-vous allé(e)s, qui avez-vous rencontré? En plus, donnez au moins trois informations sur la personne que vous avez rencontrée.

Continue

Soyez patient svp ! It can take 30-45 seconds for the videos to load. Merci ! If the weather is bad, this Quest is playable from anywhere. Simply click on the icons to access the videos. Videos load faster if you're not inside a cement building.

Continue

Mais si vous décidez d'aller physiquement au QUAD, il y aura des points bonus pour votre équipe !

La fin

The completion of quests “Critique de musique” and “Voyagez !” triggers *La fin* a final conversation:

Bernadette: Bravo ! La célébrité est tellement contente avec votre travail qu'elle veut que vous soyez définitivement son assistant(e).

Continue

Elle vous propose de voyager partout dans le monde, recevoir un très gros chèque et s'amuser. *Continue*

Ou bien acceptez votre paye maintenant et refusez ce nouveau poste.

Player (option 1): Oui cela semble comme un poste amusant !

Bernadette: Bonne chance pour la suite!

Continue

IA: Please take a screenshot of your game inventory and post on Twitter so that we can see your badges and points. #VdeUVic. Thanks for playing!

Continue

Votre badge se trouve au bâtiment Cornett ! (an available from anywhere item-just click on it) Au revoir !

Player (option 2): Non merci, on a d'autres rêves à réaliser.

Bernadette: Bonne chance pour la suite!

Continue

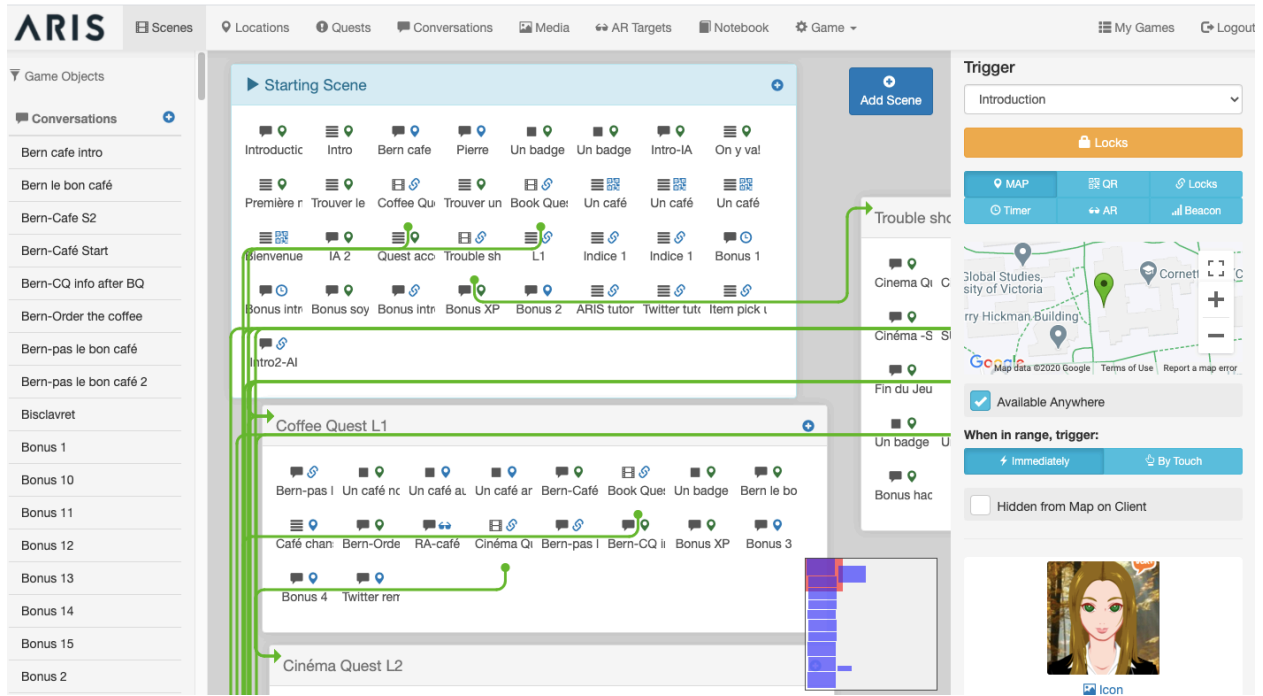
IA: Please take a screenshot of your game inventory and post on Twitter so that we can see your badges and points. #VdeUVic. Thanks for playing!

Continue

Votre badge se trouve au bâtiment Cornett ! (an available from anywhere item-just click on it) Au revoir !

The overview above shows the fundamentals of the 12 quests, including their requirements, and some of the characters and their dialogues. However, each quest also includes several other elements such as objects, hints, additional character conversations, as well as links to media. Each quest is composed of 11 to 36 game elements, and each element has its own requirements called locks in the ARIS platform. and each element has its own requirements called locks in the ARIS platform. The fundamentals of the ARIS editor focus on objects, locks, and scenes (see Figure 14). A game *object* is the media content your players will interact with and are created and visible in the left sidebar. For players to access game objects a *trigger* is employed. Triggers are added and modified in the right UI sidebar, and these control game flow by setting criteria that must be met (such as AR camera overlay feature, GPS location, timer or game logic using *locks*) before the player can access an object within a *scene*. Scenes are considered the UI main screen and the means by which to organize your game content.

Figure 12. The main UI of ARIS editor



Note. Left sidebar – create and access game objects, center screen – game elements in scenes are visible, right sidebar – trigger modification.

Appendix E Excerpt 5

Session 3 team Rouge A Fran 160 (V2 11:50-12:19 V3 00:00-4:32) duration 5 minutes 1s

1. Mary: Oui, on l'a fait.
2. Julie: Non, on a besoin de faire...sur twitter.
3. Mary: Oh ok
4. Julie: Je peux, je peux fait le tweeting.
- ...
5. Julie: Ok, le Sub avoir le service...et obviously...hmm, est-ce que c'est un mot?
6. Claire: Obviousement [all laugh]
7. Mary: Non
8. Julie: Peut tu umm.. le mot obviously? [still laughing points to other student's mobile]
9. Claire: Chercher le mot? Oui... [looks up the word on google translate]
10. Julie: Oui, merci
11. Claire: Oh évidemment!
12. Julie: Évidemment! Oh that makes sense!
13. Mary: Oh, oui évidemment!
14. Julie: É...comment? é ...non, comment est-ce qu'on...?
15. Claire: E avec un [hand signal for accent] V...oui...I
16. Julie: é...vi..de...ment évide...évidemment...comme ça?
17. Claire: Oui
18. Julie: Avec un E?...à la fin? regarde [Comparing spelling on both screens]
19. Claire: Oui, évidemment. Ok j'ai utilise Google translate [Chuckles]
20. Julie: le meilleur...
21. Claire: J'ai un peu...embarrassé pour umm utiliser [Chuckles]
22. Julie: le meilleur café sur campus...
23. Mary: Non!
24. Claire: Non?
25. Mary: Non, ça ou aussi WordReference
26. Claire: Oui et WordReference c'est bonne
27. Mary: C'est bon!
28. Julie: At ... à le? Avec un (inaudible)?
29. [All three students speak at once overlap unclear/indistinguishable]
30. Mary: Non, à le c'est *au*... je pense?...
31. Julie: avec un... comme ça?
32. Claire: Est le Sub masculin ou féminin?
33. Mary: c'est *le*, so I think it's *au*, je pense...A U...*at the*... je pense, donc *au*
34. Julie: Like the word at?
35. Mary: Yeah *at the*...or like what are you trying to say?
36. Julie: à Munchie Bar
37. Mary: oui, *at the*
38. Claire: At Munchie Bar

39. Mary: Yeah
40. Claire: (inaudible) so au Munchie Bar?
41. Mary: oui *au* Munchie Bar
42. Claire: Ok, probablement
43. Mary: je pense oui
44. Julie: Ok
- ...
45. Julie: Ok le Sub avoir le nourriture et oh non, *la* nourriture
46. Claire: Oui c'est la
47. Julie: Ok, la nourriture et évidemment le meilleur café sur campus au Munchie bar.
Ok, quel... quoi d'autre? [looking around]
48. Claire: Peut-être Felicita's?
49. Julie: Ok, aussi... il y a ?
50. Claire: Oui, il y a
51. Julie: Il y a Felicita's... avec karaoke?
52. Claire: Oui...mais umm pretty sure it's kareoké [looking up word on Google translate]
- ...
53. Claire: yeah oui c'est [can't hear the rest over laughter]
54. Mary: Oui karaoké
55. Julie: K a r e o...ké? comme ça?
56. Claire: Oui karaoké...le karaoké sur jeudi? [Laughter continues]
57. Julie: Oui karaoké sur jeudi
58. Claire: les étudiants peut (inaudible) et boire beaucoup de bière [All laugh]
59. Mary: oui [Laughter continues]
- ...
60. Julie: mes mains sont froides et c'est difficile de taper ...
61. Claire: A étudiants?... (Inaudible over Julie)
62. Mary: Étudiants
63. Julie: Est-ce que c'est correct?
64. Claire: Ah étudiants? c'est...(Inaudible over Julie)
65. Julie: C'est en anglais les... clés
66. Claire: Oh ok
67. Julie: Ou des étu...
68. Mary: Ou...the u has an accent [points to *ou* on screen]
69. Julie: Merci
- ...
70. Julie : Ok étudiants boire beaucoup de bière [All laugh] C'est un bon...
71. Claire: Une? C'est une bonne bière...
72. Julie: Quoi ? Une bonne? I was gonna say c'est un bon hangout
73. Marie: Un quoi?
74. Claire: Oh [Laughter] umm une bonne (inaudible)
75. Julie: (inaudible) [Laughter]
76. [All three students speak at once overlap unclear/indistinguishable]

77. Claire: I E it's a great place
78. Mary: Un bon ...
79. Julie: Le SUB avoir la nourriture et évidemment le meilleur café sur campus au Munchie bar.
80. Claire: Aussi il y a Felicita's avec karaoke...karaoké sur jeudi où des étudiants boire beaucoup de bière.
81. Julie: Et tweet
82. Claire: Mot cliquer [All laugh]
83. Mary: mot-*clic*