The Effects of Mobile Collaborative Activities in a Second Language Course

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ABSTRACT

This research is designed to explore the areas of collaborative learning and the use of smartphones as a support for collaborative learning through a year-long exploratory multiple case study approach integrating both qualitative and quantitative data analysis. Qualitative exploratory interviews are combined with Multidimensional Scaling Analysis to provide a detailed image of students’ mobile use during collaborative activities. The Multidimensional Scaling (MDS) reliability is supported by a second resampling that produced similar results independent of time or subjects. The results are triangulated across the qualitative and quantitative data and key issues are interpreted and discussed. The results indicate that the introduction of mobile access collaborative homework to a second language English class in Japan does have observable effects on students, including changes in use of space, time and method for mobile collaborative homework.

Keywords: Case Study, Collaborative, EFL, Japan, M-Learning, Mixed Methodology, Mobile, Multidimensional Scaling, Smartphone

INTRODUCTION

This study was designed to add to the understanding of how smartphones, used in a second language course for collaborative learning activities, impact the students’ learning habits. This study is set at a university in Tokyo, Japan, and the research students are native Japanese speakers who have studied English as a foreign language (EFL) for eight years. The central research question of this study is, “Does the use of smartphones for homework affect the relationship between Japanese university students, their mobile phones, and their homework?” The results of the study suggest that the use of mobile phones did impact this relationship in 3 ways; the time of collaboration, the space in which collaboration took place, and the method by which collaboration took place.

In the context of language learning, instructors need to understand the most effective ways to encourage collaborative learning to encourage second language communication. At the same time, it is important to consider the context of the students and the tools that are familiar to them.

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The affordances offered by smartphones for learning such as anywhere, anytime communication and data gathering contribute to these considerations.

**LITERATURE REVIEW**

**Time and Space**

Modern telecommunications is increasingly leading to a description of time as being compressed (Harvey, 1999), global (Adam, 2013), and instantaneous (Urry, 2002). Time is seen less as continuously linear and more as a multitude of individual moments (Adam, 2013) such as home, school, and work time. This view could mean very different patterns of interaction between students when collaborating through a mobile phone. The mobile phone supports this idea of time because it allows communication during previously unproductive periods of time (BenMoussa, 2003; Perry, O’hara, Sellen, Brown, & Harper, 2001) such as when traveling, so increasing the number of possible activities (Johnsen, 2001) like finishing homework (Virvou & Alepis, 2005). Likewise, space is less about localized presence as mobile technology separates space from place (Giddens, 1990). This mobility replaces the impression of being at a place for communication with a telephone, to belonging to a network of communication (Geser, 2004). This network membership means that the importance of traditional boundaries in physical space is changing.

Smartphones have created simultaneity of place (Traxler, 2009), a kind of bridging of physical spaces like home, school, and work, through the creation of a mobile social space, filling the gap between them (Bull, 2005). Mobile technologies transport communities and discussions into physical public and private spaces forcing people to adjust their behavior to manage a more fluid environment (Traxler, 2009). Private is no longer just what happens when physically alone (Cooper, 2002). A student on a crowded train may have a private moment enjoying a favorite movie or silently texting a close friend. The advance of mobile communications has brought with it a blurring of public and private boundaries; however, it is still unclear what the impact of such fundamental changes will have on collaborative learning and learning in general.

**Collaborative Learning**

Collaborative learning (CL) has its theoretical base in sociocultural theories, and places students in pairs, groups or communities of learning where they work with others to form questions, discuss ideas, explore solutions, complete tasks and reflect on their thinking and experiences (Laurillard, 2009; Stahl, Koschmann, & Suthers, 2006). In CL, learning is situated in student-centered activities (Wang, 2007) in which they establish shared meanings and develop critical and reflective thinking skills. Knowledge and understanding can be helped by collaborative work on topics that require genuine discovery together with peers who offer differing opinions for discussion (Damon & Phelps, 1989; Doise, Mugny, & Saint James-Emler, 1984; Howe, Tolmie, & MacKenzie, 1995).

In a collaborative group, the insights created and assimilated go beyond what could be managed independently (Tomasello, Kruger, & Ratner, 1993). CL is a social construction of knowledge where individuals are members of a group, but members remain engaged in a shared task using negotiation and shared meanings (Stahl et al., 2006). Social interaction between peers is fundamental to achieving learning (Dillenbourg, 1999). In a CL activity, usually three to five members take part in a coordinated effort to learn a specific educational objective (Dillenbourg, 1999) in a real social interaction context (Zurita & Nussbaum, 2007). The communication af-
fordances offered by mobile phones make them particularly well suited to the latter CL activities that benefit from continuous and spontaneous interactions.

**Mobile Learning**

Mobile learning may take place in one fixed location or on the move, in a formal educational setting (school) or a non-formal one (museum), and use one technology or several (Sharples, 2009) allowing access from anywhere to people and services. There are changes in the context of learning and the role of mobile technology as a mediating tool that can operate across ever changing contexts and learning spaces (Pachler, 2010) as people move through their day. Instead of the world being reduced to a chapter in a textbook, the learning experience can be situated in the real world of the learner (Lave & Wenger, 1991; Pachler, 2010). However, learning across contexts poses problems for evaluation because there may not be a fixed observation position and the learning may spread across locations and times (Motiwalla, 2007; Sharples, 2009; Traxler, 2007).

Seamless learning is the connecting of learning experiences across locations, times, technologies or social settings. Mobile technologies are enabling this to happen, so learning can continue across contexts, allowing work started in the classroom to be continued at home and ideas that occur on the move to be shared with colleagues online, and then followed up in person (Sharples et al., 2013.)

In a review of the literature, Naismith et al (2004) suggest six mobile learning activity categories. The first is behavioral activities such as delivering content, texting, and feedback response by the learners. Next, there are constructive activities in which learners create knowledge, ideas, or concepts such as creating and sharing media. Then there are situated learning activities, which take place in natural and authentic contexts such as providing museum visitors with access to mobile devices to access information on the exhibits. Collaborative activities promote social interaction and communication like texting, email, posting to websites and synchronous chat. Informal, contextual, lifelong learning activities occur in an individual’s everyday life like mobile applications for language learning, bird call identification, and healthcare information. Finally, there is coordination of learning and teaching such as mobile access to resources, schedules, assignments, data, and reports.

There have been many projects related to mobile learning, but several of them stand out as important milestones (Kukulska-Hulme, Sharples, Milrad, Arnedillo-Sánchez, & Vavoula, 2011). The HandLeR system established the concept of mobile and contextual learning outside the classroom (Sharples, 2000). The MOBIlearn Project established the viability of handheld technology to support context-sensitive learning in non-formal settings. The mLearning Project concluded that mobile learning can work, reaching places that other learning cannot and that it is best provided as part of a blend of learning activities rather than a single solution. Also, it demonstrated that mobile learning is not simply a tool for delivering material but can be used for learning through creativity, collaboration and communication (Kukulska-Hulme et al., 2011.)

The technology has also been proven as an effective channel for providing inexpensive distance education for varied purposes in Asian countries like South Korea, Bangladesh, Malaysia, and Japan (Vosloo, 2012.) Mobile Assisted Language Learning (MALL) with its application to foreign language instruction has been the topic of hundreds of studies. However, few of these have progressed beyond the pilot testing phase or have been the subject of follow-up reports of curricular integration (Burston, 2014.) While the necessary technological base and pedagogical expertise to make MALL a central part of foreign language teaching exists, it remains marginal in terms of the number of students and courses involved, the duration of implementations, the
language skills targeted, the kinds of learning activities undertaken and the methodological approach used (Burston, 2014.) Byrne and Diem (2014) also noted that the difficulty of gathering language app data from learners not tethered to a classroom or instructor was one reason for the small amount of concrete research on autonomous mobile language learning.

In the Japanese context (the focus of this paper), Jung (2012) found that four factors influence stress in Japanese students participating in online CL in English: Self-efficacy, Instructional Design, Technology Use and Collaborative Process. Some research findings suggest that adult learners’ intention to use m-learning is influenced by their cognitive, affective and social needs through attitude (Hashim, Tan, & Rashid, 2014.) Wang and Smith (2013) described a three-year mobile phone based language learning project in Japan. Their results indicated that the success of any mobile learning project could be dependent upon providing engaging learning materials of reasonable length, a sufficient degree of teacher monitoring, student involvement, student incentives, a respect for privacy, and a safe and secure mobile learning technical environment. Pasfield–Neofitou (2012) discusses the results of a multi-site, longitudinal study examining how second language learners of Japanese establish and maintain relationships using a second language (L2) online in their daily lives as a resource, and a way to increase opportunities for L2 use and acquisition. She found that being part of an L2 online community of authentic speakers was the most important source of motivation for language production identified by the participants in the study. Jung (2014) did an action research investigation of three scaffolding strategies for wiki-based multicultural Japanese language learning: worked examples, grouping, and peer assessment. She found that the use of a template explaining the learning objectives and expected learning process was more effective than detailed worked examples. Also, she found that heterogeneous grouping and internal and external peer review were relevant factors and that wiki-based CL can be culture laden and in conflict with traditional teaching and learning.

Kondo et al. (2012) did research at several universities in Japan exploring the use of MALL practices to help improve students’ scores on the TOEIC Listening and Reading Tests. They concluded that the use of MALL encouraged study without teacher intervention in terms of time spent on tasks, level of satisfaction with tasks, and self-measured achievement. A Ubiquitous Learning Log was studied in Japan as a means of digitally recording what a learner has learned in daily life using ubiquitous computing technologies, and the results showed how it could be used to facilitate seamless learning (Ogata et al., 2014). Lin (2014) studied the effects of using mobile tablet PCs in an online Extensive Reading Programme (ERP) on adolescent English learners’ online activities, reading ability and users’ perceptions. The results indicated that the mobile group outperformed the PC group in online activities, reading achievement, and showed a greater appreciation of the online ERP than their PC counterparts.

**Japanese ICT Context**

In Japan, the first experimental computer network connecting three universities in Tokyo was put in use in 1984 (Okada & Matsuda, 2000.) Today, according to the Ministry of Education, Culture, Sports, Science and Technology (MEXT) (2014a) Japan has a high rate of internet adoption among its general population. The Japanese government, as part of its commitment to reduce the global digital divide, is building an education and training system called J-Net (Moore, 2013.) Japanese support for the Global Development Learning Network (GDLN) began at the time of the 2000 Okinawa G8 summit when Japan announced the J-Net initiative, with plans to establish 30 core centers around the world. The first partnering of GDLN with a regional network was with the Monterrey Institute of Technology (ITESM) in Mexico in 1999. The World Bank coordinates GDLN in a partnership of over 120 recognized global institutions in some 80 coun-
tries (GDLN, 2014.) MEXT has collected data that indicate Information and Communications Technologies (ICT) are advancing in all areas of society (MEXT, 2014b.) They have placed an increasing level of focus on training children to use information and respond proactively to the Information Society by using ICT. Also, they encourage teachers to use ICT to achieve easily understood lessons and work more efficiently. MEXT is actively engaged in introducing ICT into school education and implementing policies to promote the use of ICT in lifelong learning and social education to provide the Japanese population with diverse opportunities for learning (MEXT, 2014b).

In April of 2002, MEXT reformed the Japanese English education guidelines (MEXT, 2001) ordering many primary schools to start teaching oral English as part of an initiative to improve international understanding (MEXT, 2014d).

**METHODOLOGY**

Both qualitative and quantitative research methods were utilized in an exploratory multiple case study over one academic year. The purpose was to gain a deeper understanding of the processes and outcomes of the completion of CL activities through smartphones by Japanese university students in order to answer the research question: “Does the use of smartphones for homework affect the relationship between Japanese university students, their mobile phones, and their homework?”

**Participants**

In this study, two independent sample groups participated; one group from 2011 and a second group from 2015. The first sample from 2011 formed the main case study units of analysis consisting of four subgroups of students, and the context was their participation in mobile collaborative activities within an EFL course on the topic of translation. The students were all aged between 18 and 20 years and were all living in Japan. These four groups contained five to eight participants and were selected from second-year undergraduate students on a voluntary basis. Group one included five females and two males, group 2 contained eight females, group 3 contained six females and group 4 contained six females for a total of 27 subjects.

In order to test the reliability and validity of the initial 2012 MDS result a second round of MDS analysis was performed. The second sample from 2015 consisted of similar volunteer students from the same department and same age range as the first sample group. However, the second sample group members were from two Speech Communication classes. This group contained 31 students, 29 females, and two males. As in the 2011 study, the small number of male students did not allow for a balanced gender ratio. This second sample group completed the identical word association survey as the first sample group and under the same online conditions. The purpose of having this second sample group was to demonstrate the reliability of the Multidimensional Scaling (MDS) results regardless of time or subject. Therefore, this second sample group in 2015 did not take part in the collaborative activities nor did they receive interviews or any of the other data collection methods that were utilized for the first 2011 sample group.

An ethical consent letter, containing terms and conditions for participating in this project, was given to the participants, signed, and returned to the researcher before any data was collected. The students were informed that participation in this research would have no effect on grades and that all students, whether research subjects or regular students, would complete the identical activities.
A gender balance of males and females was attempted but was not possible due to the high percentage of female students in the school. One explanation for the gender imbalance in the sample caused by the small number of male students in the department can be explained by the greater tendency of Japanese males to go into technological and business-related fields. According to MEXT, in 2012 of the 1,134,515 students who graduated from high school in Japan, 10,994 (9,080 male and 1,914 female) went on to technical colleges, and 64,063 went on to three-year colleges (7,073 male and 56,990 female) (MEXT, 2014c; NWEC, 2013.) Since the students who took part in this research were all studying English as their main subject, this data suggests that it is not unusual for there to be a higher percentage of female students.

**Collaborative Activity**

The intervention used in the initial 2011 study was in the form of small group CL activities presented as weekly modules that were accessible on a private class website by either a mobile phone or computer. These activities consisted of homework questions related to translation issues that are relevant when moving between the Japanese and English languages. Prior to each of these activities, the particular topic of the activity was discussed in the classroom and included theoretical concepts, terminology, and practical examples. The homework activities were all collaborative in the sense that they required the individual members of each group to find and upload their answers to the class website, to comment on other responses, and then to decide upon a best single answer from their group answers. The members of each group communicated as a whole by uploading a text message with or without some other media such as photographs to the website forum. It is important to note that none of the students in the 2011 or 2015 samples had previously been asked to do homework activities through a smartphone. They were able to access class information via their smartphones and submit assignments through computers, but they had never taken part in collaborative mobile homework activities like those in this study. Limitations were put on the number of messages to reduce the chance of students feeling forced into a never-ending activity. A minimum of three messages from each student was required; one initial example, one comment on another student’s example, and one choice of best example from the group. The maximum number of responses in which they were to complete the activity was set at ten, after which they were not expected to continue the activity. However, some students did choose to continue commenting past this limit.

**Interview Coding**

A list of usage patterns emerges from each of the 2011 sample student interviews which then inform the production of probing and follow-up questions. The interviews were 30 minutes long and face-to-face involving one interviewer and one subject at a time. The coding for this research was a form of thematic analysis (Ezzy, 2002), which refers to the identification of themes or concepts that are in the data, the building of a systematic account of what has been observed, and the emergence of a theory through the coding process. Also, website activity and devices used were recorded as log data through two logging systems. This data was also analyzed for patterns of use that would support the interview coding themes and MDS results. This combination of three data sources allows for triangulation of the data to improve validity and reliability of the results.

The interview coding for this research was done in the NVIVO software environment. A form of thematic analysis and coding (Ezzy, 2002) was used. Thematic analysis refers to the identification of themes or concepts that are in the data, the building of a systematic account of what has been observed, and the emergence of a theory through the coding process. This way the coding links the data to the emergent theory. This kind of analysis is more inductive than
content analysis because the theme categories are not decided prior to coding the data but are induced from the data. This sequence means that the research could lead to issues and problems that were not anticipated. All interviews were transcribed immediately following the interview and all coding was done by a single researcher.

The first stage of coding is referred to as open coding and consisted of the naming and categorizing of phenomena through the close examination of the data in order to generate an emergent set of categories and their properties (Ezzy, 2002). The next step was axial coding that is the integrating of codes around the central categories by specifying a category in terms of the conditions that created it; the context in which it is embedded; the interactional strategies by which it is managed; and the consequences of those strategies (Ezzy, 2002). Finally, theoretical coding involved the identification of the core category around which the analysis is focused. The coding process was finished when the researcher believed that the data was saturated so that the analysis could produce no new codes or categories, and all the data was accounted for in the core categories.

**Multidimensional Scaling Analysis**

Multidimensional Scaling is a well-known group of data analysis techniques that represent the data’s structure in a spatial fashion to make it easier to assimilate. The following are some examples of research studies that have utilized MDS for building, comparing and ranking, and visualizing data in many areas of research. MDS has been used to build an effective speech corpus (Nagino, Shozakai, Tomoki, Saruwatari, & Shikano, 2008), and a typology of negative mentoring experiences (Simon & Eby, 2003). Also, it has been effective for comparing and ranking interpersonal adjective Scales (Adams & Tracey, 2004), motives and causes for absence from school. (Bimler & Kirkland, 2001), test item similarity ratings (Sireci & Geisinger, 1992), cross-cultural satisfaction with friends in Japan (Maeda & Ritchie, 2003), perceptions of ethical role responsibilities (Pang et al., 2003), and cross-cultural values for women and men (Struch, Schwartz, & Van Der Kloot, 2002). Several researchers have used MDS for visualizing data such as cultural proximity matrices (DeJordy, Borgatti, Roussin, & Halgin, 2007), item response data for the TOEFL test sections (Olzman & Stricker, 1990), interests of Native American college students (Hansen, Scullard, & Haviland, 2000), social distance among multi-ethnic groups (White, Kim, & Glick, 2005), children’s representations of their peer group (Lease, McFall, Treat, & Viken, 2003), and the relationship between values of family firm’s founders (García-Álvarez & López-Sintas, 2002.)

At the foundation of MDS is the Young-Houholder theorem (Young & Householder, 1938.) This influential theorem demonstrates that n x n Euclidian distance can be represented by n points in n-dimensional Euclidian space. In this study that means the 25 x 25 Euclidian distance matrix can be represented by 25 points in 25 dimension Euclidian space. From this theorem, Torgerson developed Classical Multidimensional Scaling (Torgerson, 1952). In Classical Multidimensional Scaling, n dimensions can be approximately reduced to much fewer dimensions so that they can be visualized. In this study, the 25 dimensions were reduced to two dimensions for the purpose of visualization in a two-dimensional plot. The accuracy lost by the removal of the other 23 dimensions of information can be evaluated by the fitness of the result. A good fitness means that the two selected dimensions are enough to represent the 25 dimensions accurately, so 23 dimensions are not considered important to the explanation of the result. As is stated in the results section, the fitness of all 3 MDS analysis in 2011, 2012, and 2015 are very good at around 0.05.

In addition to the interviews, at the beginning and the end of the data collection period the participants in the 2011 and 2015 sample were given an online word association questionnaire to complete and the results were analyzed using an MDS technique. The MDS analysis was per-
formed in the R statistical environment (Team, 2015.) MDS is a method for capturing efficient information - closeness of data and efficient grouping of data - from observed dissimilarity data by representing the data structure in lower dimensional spatial space. The purpose was to gain a picture of the participants’ relationship to school, homework, and the mobile phone. It is hoped that by analyzing this word association questionnaire the researcher would be able to see any shift in the changing relational position of the words.

The data for the MDS analysis is numerical and in the form of symmetric similarity data consisting of student perceptions of the similarity among the following 25 English words: Afternoon, Alone, Computer, Dictionary, Discussions, Education, English, Evenings, Groups, Home, Homework, Listening, Mobile Phone, Morning, Night, Outside, Picture, Reading, School, Speaking, Text, Traveling, Video, Voice, Writing. These words were chosen by the researcher to represent aspects of the students’ lives including times of day, locations, number of people, activities, education, and technology. Times of the day were represented by Morning, Afternoon, Evening, and Night. Locations are represented by Home, School, Outside, and Traveling. The number of people is represented by the words Alone and Groups. Activities are represented by the words Discussions, Homework, Listening, Reading, Speaking, and Writing. Education related words included Education, Dictionary, and English. The technology related words include Mobile Phone, Computer, Text, Picture, Voice, and Video. In future research, words could be added or removed. For instance, there are no words representing people in the lives of the students which if included may allow for a more meaningful interpretation. Also, a re-coding of the interview transcripts could identify some frequently occurring words such as Entertainment and Free time. These changes are for future research and will not be discussed further in this paper.

The word associations formed a 25 x 25 matrix of all possible word pairs. The students were asked to enter a value from 0 to 5 in the box at the intersection between each set of words that represented their perception of the strength of the relationship between the words. The participants were given the following number to meaning relationships as a reference: 0 = NO relationship, 1 = very distant relationship, 2 = distant relationship, 3 = close relationship, 4 = very close relationship, 5 = extremely close relationship. The April 2011 data matrix used for the MDS analysis is included in Table 1.

After the participants had completed the data-entry form, the total marks for each word intersection over all of the participants were added. So each number represents the total of all values given by the students for each row word and column word pair. A higher number indicates a greater number of participants perceived a stronger similarity between the word pairs. This type of data is known as proximity data that consists of measures of similarity or dissimilarity between objects of interest (Everitt & Rabe-Hesketh, 1997.) In this case, the objects of interest are the row words and the column words. The output from MDS is in the form of a plot of all the objects (words), and the distance between them shows the value of dissimilarity. In other words, the higher the perceived similarity then, the greater the number from 0 to 5 and closer the words appear in the two-dimensional plot.

The aim of using more than one approach is to compensate for the weakness of one method by drawing on the strength of another, so giving some assurance of the completeness of the research. Also, it can confirm the validity of findings when data from different sources or methods converge (Mathison, 1988) on the same result. However, researchers might find that the different approaches used in triangulation obtain conflicting results, which would indicate that they need to collect more data. In addition to the convergent and inconsistent results, there is the possibility that the different approaches used in a triangulation could obtain results that do not support the research question, which would mean that the researchers need to rethink their initial question.
RESULTS

The results of the qualitative and quantitative data collection including interviews and MDS analysis are detailed in this section. First, the MDS analysis data for the 2011 sample from the first questionnaire results of semester one in April 2011 and the second questionnaire results of semester two in January 2012 are shown as a plot in Figure 1. Since this outcome was a comparison of two results, one from semester one and the second from semester two, data from only those participants who completed both questionnaires could be used in the final analysis. So, from the 2011 sample, there were a total of 22 out of a possible 28 response sets that were used for the MDS analysis comparing semester one and two. Each of these words is represented by a number from 1 to 25 and a letter, a for semester one or b for semester two. These two separate results were combined into a supermatrix containing both results to ensure that the scaling was mathematically identical; otherwise a comparison would be meaningless. Due to space requirements this supermatrix data table was not included in this paper. The arrows were added to Figure 1 to clarify the movement of the words from semester one to semester two. Most of the points seem to be moving towards the center. The largest changes were seen in the words “alone” (2), “homework” (11), “mobile phone” (13), “outside” (16), “text message” (21), and “writing” (25). After the researcher had reviewed the placement of the words, a possible description of the two dimensions became noticeable. At the bottom of the plot, the word “groups” (9) appears and at
the very top is “alone” (2), so the vertical dimension was interpreted as representing the change from words related to a group of people to words related to being alone. On the far left side the words “evening” (8), “morning” (14), and “night” (15) appear which are times that are often spent at home in private. While at the far right side appear “education” (6), “English” (7), “groups” (7), and “school” (19). Since the participants are all students attending school to study English, this all relates to the very public activity. Because of these placements the horizontal dimension was interpreted as representing the movement from private life to public life. Following this interpretation, the lower right corner cluster including “outside” (16), “traveling” (22), and “video” (23) which are all things a person can do privately while surrounded by a group of people. The cluster at the right middle made up of “afternoon” (1), “evening” (8), “mobile phone” (13), “morning” (14), “night” (15), and “picture” (17) could be seen as private times and places when you are surrounded by one or two people. An example might be at home in the morning eating breakfast with their parents. This interpretation is supported by the proximity of this cluster to the word “home” (10). The cluster at the bottom right includes “discussion” (5), “groups” (9), “listening” (12), “speaking” (20), and “voice.” These are all related to things a person would do in public with several people. An example might be English language students in a classroom working on an assignment. This interpretation is supported by the proximity of the small cluster made up of the words “education” (6), “English” (7), and “school” (19). Finally, in the top right corner appears “computer” (3), “dictionary” (4), “homework” (11), “reading” (18), “text message” (21), and “writing” (25). These were interpreted as words relating to things done alone that are related to their public life. An example is a student at home alone in their room using a dictionary to write the answers on a homework assignment for school.

Next, to test the reliability of the 2012 MDS analysis, the identical survey was given to a second sample group in 2015. The idea is that if the second result is a close fit to the first result then this will be evidence of a high level of reliability for the MDS measurement of the perceived similarity between the words. The result of the second 2015 sample was combined into a supermatrix with the April 2011 and January 2012 results from sample group one. These combined results are represented in Figure 2 in which each number corresponds to one of the 25 words, and the letter a indicates sample one April 2011, b is sample one January 2012, and c is sample two 2015.

When we compare the results from the 2011 sample in Figure 1 and the combined 2011 and 2015 sample in Figure 2 the clustering of words and position are very similar. Taken individually, the fitness of the first MDS sample in 2011 is 0.0561, the second MDS sample in 2012 is 0.0577 and the final MDS sample in 2015 is 0.0637. When these are combined into a supermatrix, the result has a fitness of 0.0583, which is similar to the fitness of a, b, and c separately. The relative position of words to each other is very consistent regardless of time, three years between samples or sample subjects. This resampling indicates that the scales and the interpretation of the two dimensions are mathematically similar over the three times, which demonstrates the high reliability of the analysis.

This similarity of the MDS results in spite of time, 2012 to 2015, gender inequality, changes in technology suggests that a fundamental affordance of the technology as responsible for the central location of mobile phone in the lives of the students. This may be due to the fundamental affordances provided by the technology that are relatively stable over time and technological evolution, such as, portability, anywhere and anytime communication, and data collection and access.

Finally, since the MDS analysis is not sufficient evidence to base conclusions on alone, interview data was collected to allow for data triangulation. The participants in the 2011 sample were also asked to participate in two interviews. The first was at the beginning of the Japanese
School year in April followed by a second at the end of the same academic year in January. At the end of the year, group one had completed 12 individual interviews; group two had completed 15, group three had completed 10, and group four had completed 11. Altogether, this made a total of 48 individual interviews that averaged 30 minutes in length each for a total of 1440 minutes. These interviews were transcribed and then coded for themes.

**DISCUSSION**

The coded themes from the interviews suggested the collaborative intervention did affect the relationship between the students, the smartphones, and the homework. The themes were examined further in light of the MDS analysis and the intervention did appear to have affected the relationship in several ways including time of collaboration, space in which collaboration took place, and the method by which collaboration took place.

**Time of Collaboration**

The smartphones appeared to have encroached on private time that would otherwise not have been used for homework collaboration mediated by face-to-face or computer communication. These times included that spent commuting, doing daily activities, and socializing. Students reported in interviews that the smartphones made it possible for them to continue the homework.
activities while commuting to and from school, which they felt increased the available time for the activities. While traveling in trains or walking in the street, the students also reported that they could use the smart phones to do the homework collaboration and data collection activities related to the homework. For example, the students were tasked with finding translation examples throughout the city and share them with their homework group. The constant presence of the smartphone afforded the students the ability to record examples from authentic sources such as signs and advertisements as they walked around the city and allowed the students to continue the homework during shopping trips or in restaurants. Before this research, the students reported using their train time to sleep or to do some form of entertainment on their smartphones. There was a very positive response to the opening up of this previously free time to homework activities. They could now use this time to read and reply to their group members’ comments throughout the day. This continuous mobile access allowed them to keep on top of the group activity with frequent visits to the homework website that they reported would not have been possible if there were not a mobile access option.

During the year, the students reported that they started doing the homework while they were with their friends at lunch or socializing out at night. Many of the students began checking the website during lunch time with their school friends. Some students also began to check the homework site while out at night with their friends. This activity was reportedly quite common when the homework deadline was approaching. However, one student eventually decided to stop using a mobile phone for homework during lunch time because she decided just to spend that time with her friends.
The mobile phone did affect the students’ use of time as the mobile phone meant now they did not have as great a need to coordinate exact times for communication. Instead, they reported using brief moments that are only approximately aligned with their group members’ schedules (Ling, 2004; Plant, 2002; Sørensen, Mathiassen, & Kåkhara, 2002). The students created moments of temporarily stable contexts while commuting and walking around by searching for and collecting translation examples for the activities. This activity allowed them to enable meaning-making within the flow of everyday activity without forcing a great change to their schedules (Kukulska-Hulme et al., 2011).

**Space of Collaboration**

The students also reported that the spaces used for homework started to change as they became more comfortable with using the smartphone for homework. The students began bringing the homework into places in which they had either rarely or never done this type of collaborative homework. This change in the spaces in which collaboration took place was observable in a variety of forms and included the mobile phone as a private space, home as a more frequent place for homework, and work as a new location for homework.

A smartphone is considered a private and very personal device to the students. All of the students in this research reported in the interviews that they received their first mobile phone from their parents when they were around ten years old so that they could keep in contact with their family. The personal nature of the mobile phone in the lives of the participants can be seen in Figure 1. In semester one, the word “mobile-phone” (13) is positioned on the “private” side of the horizontal dimension and between “alone” and “group” on the vertical dimension. In addition, “mobile phone” (13) is next to the four times of the day, “morning” (14), “afternoon” (1), “evening” (8), and “night” (15) which suggest it is with them throughout the day. In the interview data, another commonly reported reason for having a smartphone was for entertainment while traveling. Several students said that the smartphone seemed to allow them to create a private space even when in a crowded train. This is supported by the location of “traveling” (22) and “outside” (16) in the lower left corner of the plot representing private and group; the smartphone creates a private space within the larger crowd. At the same time “alone” (2) is at the opposite end of the plot suggesting that the students are aware of a difference between being alone and being in a private space. In this private space, they reported being able to interact comfortably with the homework website, check social network sites, play games or watch videos even on an extremely crowded train.

Through the smartphone, homework gained a stronger foothold in the home. Many students mentioned that the speed and ease of using a smartphone were attractive because it allowed them to check the homework without the need to sit at their desk with a computer. In the morning, while preparing for school, they would check the website for new comments on their posts. For some students, the smartphone was the first thing they reached for after waking up. The device stayed with them as they moved around from the bedroom to the kitchen table and out the door to the train station. At all of these times, the students reported that they were able to check the homework website regularly. Then, after returning home, they would commonly reply to their group while lying in bed before going to sleep, even when a computer was available in the same room. In Figure 1 there are some indications of this in the movement of “home” (10) towards public on the horizontal dimension and “homework” (11) moving towards group on the vertical dimension. This mobility afforded by the smartphone allowed the homework to move into these small but very personal spaces in the students’ homes.
The smartphone also allowed the collaboration to continue into the workplace of the students. Many of the students had part-time jobs that take up a significant amount of their out-of-school time, often running late into the night. The smartphone access allowed them, for the first time, to immediately connect with their group’s web page and contribute to the discussion, even during a short 15-minute break. Before this course, the students reported that they had only used their mobile phones to access data on the schools web site and to communicate with friends, but had never used them as a means of direct collaboration for a homework assignment. The word “work” was not included in the MDS word list, but “night” (15), when most students worked, did shift towards the public end of the horizontal dimension reducing the distance with “homework” (11). Without this mobile access option, the students reported in the interviews that there would be less time available for them to use for homework activities.

The smartphone appears to allow the students to separate the idea of learning space from physical space so that it is less about being at a place and more about belonging to a network of learning (Geser, 2004; Giddens, 1990). The smartphone blurred the students’ traditionally clear boundaries between school, work and home allowing one to invade another as has been observed with at home company workers (Schwarz, Nardi, & Whittaker, 2000). Now, even when physically alone at home the students could enter into a virtual public space discussion with their group members (Cooper, 2002; Sheller, 2004). Similarly, when in a crowded area they were able to construct a virtual private space with the smartphone. This continuous access to communication and data collection through the smartphone allowed the activities to be situated in the everyday environment outside of the classroom where the students would most likely be using their language skills (Lave & Wenger, 1991).

Methods of Collaboration

The role of the smartphone as an essential communication tool and its ability to switch effortlessly between the private websites and the public homework site places the device as a bridge between public and private life. There were reported changes in the communication method used for collaboration that were observable in a variety of forms that included feelings towards the mobile device, non-friends, private websites, and language.

The smartphone shifted homework into a more central relationship with many aspects of the students’ personal lives. In Figure 1, “homework” (11) and “mobile phone” (13) have both moved towards the center of the plot. The close personal connection that the students reported having with their mobile phones may have affected their feelings towards the homework. When using their smartphone in place of a computer, they reported feeling a greater sense of familiarity with the homework, which they felt brought them closer to the topic under discussion. Also, they reported a reduction in their nervous feelings that were associated with homework done through other non-mobile methods such as computers. The students associated “computers” (3) with “homework” (11) much more than with “mobile phones” (13). It may be that this nervous feeling they reported when associating computers with homework will eventually be shifted to smartphones as they become more commonly linked to homework activities in the minds of the students. However, this study was too short to identify anything more than the initial positive reactions of the students.

The smartphone affords the ability to switch quickly and easily between mobile applications whether they are for entertainment or homework purposes. During interviews, this ability was described by the students as creating a greater sense of closeness between these two separate aspects of their lives - the private entertainment and the public homework - so that they both seemed to be in the same space or shared presence on a network. In the interviews, some par-
participants reported that this feeling of shared presence of entertainment and homework reduces both the perceived distance and the physical effort required to switch between them, so reducing the motivational barrier needed to start a homework session.

The boundary between friends and others is blurred by the smartphone so possibly increasing the development of close relationships. The smartphone use for homework reportedly allowed the students to communicate more with their group members because the phone was always present so reduced the need to meet face-to-face. While the students were happy to discuss the topic face-to-face with friends, they did not like the idea of meeting face-to-face with group members that they did not already know. They mentioned that they would not have talked with these unfamiliar group members at all if the homework were just face-to-face. However, the same students felt that the smartphone offered a comfortable way to start communicating with those students that they would otherwise not speak with, resulting in an increased chance of getting to know them better.

As the year progressed, mobile social network sites (SNS) that the students had previously used only for very private friends began to be used as another channel for communication. Mobile SNS, such as Twitter and Mixi, were clearly identified by the students as something they would not like to use for homework. In the interviews, all of the students mentioned that these SNS were accessed exclusively through their smartphones. Some students strongly expressed a need to keep some part of their lives private from school so that they would have a way to relax. Initially, the SNS were identified by many students as that private place in which homework is not allowed. However, this attitude changed over the year as the students started to incorporate their social networks into the collaboration process. They began to use these systems as secondary notification channels by which their friends in the group could request an immediate and private comment on their posted homework message. These requests were also seen by friends who were not in their group or even at their school, so they were able to get feedback and advice from a broad population. Also, the students used the mobile SNS as a way to overcome the limitations of the homework site. For example, some reported that they found the interface of the commercial sites like Twitter to be much simpler than that of the homework website.

The students clearly placed their first language (Japanese), into their private world of communication but their second language (English), was used for public communications. When communicating face-to-face or on their private mobile SNS, the language of choice was Japanese. Alternatively, the homework website, which can be seen by everyone in their group including the course instructor, is an all English language environment. They were allowed short Japanese examples of a few words when explaining a translation, but otherwise everything had to be in their second language of English. This semi-public forum for their language was challenging for all the students especially those who lacked confidence in their English ability. Students used their private mobile communication channels to check their ideas in Japanese with friends and others with whom they felt more comfortable to reduce the chances of potentially embarrassing public mistakes. Also, some students reported that they were able to discuss some of the most difficult aspects of the homework in their native language that would have been too difficult in their second language.

It appears that the students began to fit the mobile learning activities on their smartphone into their already existing preferred practices (Waycott, 2004). They accessed the homework website while they were playing a game or visiting their SNS, switching rapidly between entertainment and education as a way of relieving the boredom of the commute to and from school (Lasen, 2002). The smartphone allowed students to participate in two different interactions at almost the same time (Rettie, 2005). The students would often enter their private SNS to share thoughts on the homework in Japanese because it allowed them an alternative channel of communication.
that allowed a more individual and a deeper level of communication because they were using their first language, and it was not being monitored by the instructor or strangers.

CONCLUSION

This study used a mixed methodology approach to analyze data from a case study investigating the effect of mobile collaborative activities on second language students. This was a longitudinal study that took place over the course of a year and included interviews and an MDS analysis. The reliability of the MDS analysis was supported by a second sample group of data collected using an identical survey three years later which produced mathematically similar clustering. These data sources were then triangulated and the resulting themes that appeared were supported by both the interviews and the MDS analysis.

The main research question stated in the introduction is, “Does the use of smartphones for homework affect the relationship between Japanese university students, their mobile phones, and their homework?” In answering this question, the data collected demonstrates that the mobile collaborative intervention did affect the relationship between the students, the mobile phone, and the homework, including time, space and method of collaboration.

The continuous presence of the smartphone provided the students with a means to keep in touch with their group and to collect data in the form of examples throughout the day or night. The ability to immediately switch with ease between private mobile activities and more public homework activities created a type of shared space or network where students who would not typically communicate face-to-face found themselves sharing this space so increasing the number of people with whom they could collaborate. The ability to access entertainment and homework related activities simultaneously reduced some of the motivational barriers to beginning the homework. Commonly used mobile SNS were drawn into the collaboration acting as a separate channel to communicate in their private language of Japanese which allowed them to discuss topics in greater depth and without fear of public embarrassment. While this second channel of communication may support the students, it also provides an excuse for not trying to challenge their current language ability.

These results have clear implications for curriculum design in subject areas such as language learning. Smartphone use for second language collaboration seems to change the nature of the homework from a very public activity to a more private one by bringing the homework into areas of their lives not possible with traditional technology. The practical implication of this is an improved sense of community (Lave & Wenger, 1991.) In addition, when pre-existing negative feelings are present in students the use of the mobile phone appears to erode these as the homework becomes more embedded in the private activities of the students such as mixing education and entertainment activities. This effect is an opportunity for curriculum designers to incorporate what is entertaining to the students into the course material.

The student participants often seemed to blur the lines between the use of the social networking tools and the smartphone, making little distinctions among mobile services, such as the homework website and commercial SNS. One implication of this is that the mobile phones may provide a way for instructors to strengthen the network of learning formed by collaboration by allowing students to continue the discussion as they move through physical locations (Sharples, Taylor, & Vavoula, 2005). Also, instructors could consider incorporating commercial mobile SNS already used by the students to leverage the students’ affective relationship with these services to increase motivation and student support further.
The second MDS analysis took place three years after the first, included different subjects of the same age and department, and mobile phones with more advanced features. However, the similarity of the MDS results suggests that the central location of the mobile phone in the lives of the students is determined by factors other than changes in time, technology, or participants. This suggests that the fundamental affordances provided by the technology which are relatively stable over time and technological evolution, such as, portability, anywhere and anytime communication, and data access, may have greater weight in affecting the students’ attitude to the mobile phone. In terms of curriculum design, this could support a greater focus on these fundamental affordances when planning a seamless classroom.

In the future, this research will be expanded to include a larger number of word associations in the MDS analysis that include people and other mobile devices. Also, a longer case study may be attempted that follows the students over four years to see how the associations change as the students become more familiar with the use of mobile devices for homework activities. Also, as seen in this research, the ubiquitous nature of the mobile technology may pressure the students to participate even during their private time. While this has some positive effect such as keeping the topic of discussion in the student’s mind, it may also have a negative effect on student motivation. This balance of time needs to be explored in future research. It is hoped that this will provide a more accurate representation of the position that smartphones hold in the lives of students so that curriculum designers will be better able to leverage this technology.

REFERENCES


Peter Ilic was born in England and raised in Ontario, Canada. After graduating from McMaster University with a degree in History, he traveled to Japan and has been teaching at several universities in the Tokyo area since that time. He received an MEd from Temple University and a MSc in Educational Research Methodologies from the University of Exeter in the UK. He went on to obtain his PhD in Education from the University of Exeter where he investigated the use of Mobile devices for Collaborative Learning. ICT in Education remains the principal focus of his ongoing research which has resulted in several peer reviewed publications, as well as contributed presentations.