Challenges and Opportunities for Technology in Foreign Language Classrooms

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ABSTRACT

We present the results of a two-month ethnographic study of three introductory Russian classrooms. Through observation and interviews, we identify several distinct roles played by physical artifacts in the classrooms, such as providing a reference to necessary foreign-language material and serving as props in creative role-play. The range of roles taken on by artifacts and the attitudes students have toward them provide a basis for our discussion about how technology might be more effectively introduced into the socially negotiated environment of the introductory foreign-language classroom. We identify the need to balance between collaborative and personal technology in a stressful, but social, context. Our findings inform a range of roles that technology can undertake in replacing or augmenting existing classroom artifacts.

Author Keywords

Language; language-learning; foreign; classroom; communication; Russian; artifact; textbook; students

ACM Classification Keywords

K3.1. Computer uses in education

INTRODUCTION

People learn foreign languages for many different reasons, such as for personal or professional growth, to fulfill academic requirements, as part of relocating, or to connect with others. Although people can learn individually through software and self-teaching books, foreign-language classrooms remain a popular and vital way of learning languages for people around the world [1]. However, as pedagogical practice embraces communicative approaches that encourage students to predominantly use the foreign language, the social, collaborative learning environment of the introductory classroom in particular is associated with tension and anxiety.

Learning a new language is a very difficult journey, regardless of how or why it is undertaken. In this work, we

draw upon communicative language teaching [2] and collaborative knowledge building [3] as theoretical frameworks for discussing the roles artifacts play in the classroom, particularly in student-student communication. We conducted a two-month qualitative study of three introductory university Russian classes, involving complementary observations and interviews. The many objects present in the foreign-language learning classroom, such as books and printouts, help facilitate communication among students. We relate existing work on language learning technology to our findings about the roles played by the non-technological artifacts we observed in use. We contribute design implications for creating devices to be more effectively embedded into the negotiated practices of students in foreign language classrooms.

BACKGROUND

This work focuses on student interactions facilitated by the communicative pedagogy of foreign language reaching. This is currently a popular style of language instruction, associated with a paradigmatic shift in U.S. classrooms over recent decades. This approach focuses on supporting the real and immediate use of learned knowledge for purposeful communication as a complement to more traditional analytic and rule-based teaching [2]. Savignon identifies five distinct aspects of the communicative approach: (a) *language arts*, focusing on vocabulary- and grammar-driven instruction; (b) language for a *purpose*, or communicating ideas for their own sake rather than to re-iterate lesson topics; (c) *personalized* language, encouraging students to express personally-relevant opinions and topics; (d) *theatre arts*, ranging from reading scripted dialogs to roleplaying open-ended scenarios; and (e) going *beyond* the classroom to incorporate authentic materials and cultural connections.

There are many potential advantages to incorporating technological interventions into language learning curricula, including in the classroom environment. Garrett surveyed these opportunities and recent progress toward achieving them [1]. First, interactive software and devices provide feedback in the absence of the instructor, such as during pair or small-group class activities where the instructor's attention is focused on one of many sets of students at a time. Providing corrections and guidance in an interactive manner has long been a challenge for technology in the

classroom. Second, technical interventions enable greater engagement with authentic materials, created by and for native speakers. Especially in the introductory context, these are largely unapproachable to students, who lack sufficient mastery of the language to understand many authentic materials. Even captioned movies provide benefit, but greater interactive multimedia has the further potential.

Technology is present in classrooms, in the form of CD players and PowerPoint presentations, but the roles it plays are limited in the extent to which they shape communication between students. In communicative classrooms, synchronous, co-located technology is nearly nonexistent. Offloading lecture and assignment feedback onto asynchronous software can benefit the communicative classroom, increasing both teacher and student satisfaction [4]. Placing devices into such an environment, however, has not seen any great success. In-depth ethnographic studies are crucial to understanding how to design for the needs of students engaged in collaborative language learning [5].

Computer-supported collaborative learning (CSCL) at large benefits from recognizing that collaborative knowledge building is distinct from individual knowledge building, in terms of technological needs [3]. A key role of discussion in collaborative learning is to make the tacit explicit, and negotiate breaks in understanding as a way to build understanding as a group. Actions and utterances in a group setting have no analogue for individual learning. Students rely on common ground knowledge to arrive at new, shared understanding, which is then embedded into externalized words and artifacts. This opens new needs for technology to support distributed cognition, and the externalization of socially generated knowledge.

We contribute a study of introductory Russian classrooms where we characterize how non-technological artifacts mediate collaborative learning. This characterization provides the basis for the following discussion on the possibilities and challenges in designing pervasive digital artifacts for a communicative language-learning classroom.

METHODS
We observed students in classrooms and conducted individual semi-structured interviews. The first three authors conducted qualitative fieldwork across three introductory Russian classrooms for two months, and interviewed a subset of the students from each classroom to supplement our data. We iteratively analyzed observation fieldnotes and interview transcripts, synthesizing relationships and processes into a grounded theory of artifact use and communication [6] [7].

Observations
In this study, we wanted to gather detailed contextualized data about communication and artifact use in introductory language classrooms that would help inform the design of future technologies for the classroom. We chose to focus on introductory classrooms because they provide a unique

opportunity to observe how students communicate in a language that they have minimal experience with, which gives rise to more observable behaviors than more advanced language classes. All three sections were taught in a large public university; the two larger sections were attended by first- or second-year college students fulfilling a foreign language requirement or beginning a major relating to Slavic studies. The other, evening section also had several continuing education students looking to fulfill credit requirements or, in the case of a heritage student we interviewed, to improve his knowledge of a language he had an intuition for.

The three classrooms we observed were taught by two different instructors who had each granted us permission to observe their classes. Each section was located in a different space, with slightly different layouts, as pictured in Figure 1, which affected the extent to which students could move around and engage with those not in their immediate vicinity. Two of the sections met in the mornings and afternoons, respectively, for 1-hour sessions on Monday through Friday. In the evening, there was a longer, 1.5-hour section of the class that met Monday through Thursday. The morning, afternoon, and evening sections had 13 students, 15 students, and 8 students respectively. The students were in the third part of a year-long sequence of three introductory Russian courses.
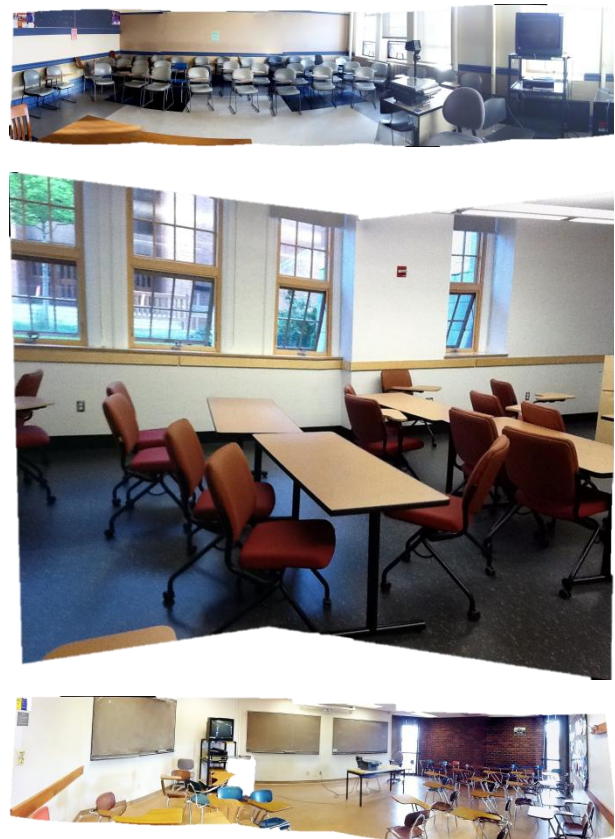

Figure 1. Photographs of observed research sites.

Over two months, we observed 33 meetings of these classes (10 each of morning and afternoon, 13 of evening) and collected data about a total of 40 hours of class time. In each class, we observed non-verbal events and verbal patterns that could be recognized without understanding Russian. One researcher, a native Russian speaker, was able to provide data and translations that complemented the behavior-focused observations made by other team members.

Observation data was analyzed first using open coding, then axial coding. Codes covered six areas: student behaviors, student acting, student affect, instructor behaviors, artifacts in the classroom, and assigned activities, focusing on the roles played by artifacts in student-student communication. A review of second-language acquisition and communicative language learning literature theoretically informed the coding scheme. Iterative analysis then revealed the key role that artifacts played in shaping communication and organizing activities; in this paper, we present artifact-centric findings.

Interviews

From the classrooms we observed, we recruited 6 students for semi-structured interviews. We spoke with 3 students from the morning class, 2 from the afternoon class, and 1 from the evening class. The interviews ranged in length from 15 minutes to an hour, averaging 45 minutes. We developed the protocol while reflecting on the findings from our observations, conducting the interviews towards the end of the study. The interview protocol prompted students to reflect about their language-learning background, the classroom environment and artifacts, the significance of student collaboration, and their emotional reactions to class activities. Interviews were audio-recorded, transcribed, and coded with a coding scheme similar to that used for observation data, relating personal attitudes and values of the interviewees to the relevant phenomena that emerged from observation data analysis.

While the observations focused on descriptions of activities that transpired in the classrooms, interviews captured reflection on those same activities. Therefore, when we used codes from the same coding scheme, we did so with the understanding of a fundamental difference: while observations might describe a researcher's observations of events during an activity, interviews will instead provide insight into the attitudes of a student toward that activity. Despite this difference, the two sources of data could be coded with parallel coding schemes to help relate different perspectives on common artifacts and activities.

RESULTS

We discovered a wide range of roles played by artifacts in supporting classroom activities and social practices. First, we will set the stage by discussing stress and joy in classroom activities. Second, we will introduce five roles played by artifacts in a rich artifact ecosystem. Third, we will discuss student-student corrective feedback as an artifact-mediated phenomenon.

Stress and joy in classroom activities

In the classrooms we observed, students engaged in a range of social activities. The fast-paced sessions were packed with pair and small-group work that involved combinations of speaking, writing, and so on. We found students to frequently speak English, rather than Russian, despite instructors' efforts to limit the use of the first language except for certain activities. English was used for *metalinguistic discussion*, figuring out how to carry out some activity as well as general commentary about the material (*e.g.*, "This doesn't seem right…" or "Does anyone else find this really difficult?" or "This word just sounds silly!"). In the framework of collaborative knowledge building, these discussions provide a way to explicate tacit impressions and negotiate misunderstanding [3] though the use of the first language makes it less desirable from the communicative language teaching perspective [2]. There is some debate in the literature about the place of the first language in these classrooms. Cook provides a review of popular arguments against use of first language, and urges a reconsideration of this stance [8]. The teacher can, for example, support spontaneous communication by translating students' first-language statements, which can then be repeated by the students. Over time, this support becomes less necessary, in the meantime increasing purposeful participation. The key stance of viewing the first language as the "initiator of meaning" makes this distinct from other forms of instructor guidance.

In our observations, English was temporarily used to bridge the gaps in understanding, including requests for clarification. English was also used for reflecting on the difficulties of their experiences as students:

> Ben and Andrey take turns staring down into Ben's book. They both ask the instructor for help occasionally. Justin, who is in another pair with Max, whines about saying 11:55pm in Russian. Max asks, "how would you say that?" and Justin hesitantly says the literal (in this case, not preferred) Russian translation for 11:55pm. They go back to taking turns; they seem to be focused on dates rather than times after a short while, and the instructor has now walked over and watches them carefully. From across the room, Andrey asks, looking at the instructor, "are we the only ones having trouble with this?" and Justin, grinning, replies, "no trust me it'll take a mathematician to get this."

This type of communication helped students develop rapport with their classmates, growing comfortable in their stressful environment. Furthermore, commenting on breakdowns in expectations of performance helped build a cohesive social understanding of material difficulty. The prevalence of reflection on the difficulty of material indicated a level of uncertainty and tension, which became more apparent in the interviews.

The classroom environment is also fraught with stress resulting from continually challenging students' knowledge in a social setting. Lane, a student from the afternoon section, said that when someone doesn't know an answer to a question from the instructor, "I feel like it's a good learning incident sometimes, and someone has to be the scapegoat, so if I am, well, fine. We take turns." Unlike Lane, another student we interviewed, Jenna prefers reading scripted dialogs in small groups, because:

> [The instructor] really likes to, kind of, pick on people, and … and get them involved as much as they can … and I kind of like that, but I'm fearful of it as well [laughs]. I like just being relaxed, and … knowing exactly what to say.
>
> *—Jenna*

This kind of stress seems to stem from the communicative approach, and colors both the group interactions between students, and the roles that artifacts play. Jenna suggests that there is a comforting aspect of the physical book in the face of uncertainty. As Lane suggests, the associated pressure sets up an atmosphere for camaraderie and joy:

> The instructor interjects a few minutes before class ends, announcing, in Russian: "and now, we improvise!" She calls on Josh and Natalie. Natalie stares, saying "uhhhhh…." and Josh starts speaking while staring into his book: "*добрый день…*" ("*good afternoon…*"). As the instructor looks at him sternly, he realizes: "wait, so no reading, then?" The instructor beckons Josh and Natalie forward. With pauses and blushing, Josh weaves together a hesitant sentence, and Natalie constructs a similarly hesitant response. There is a lot of laughing by them and their classmates throughout. At one point, Natalie comes up with, "do you have a passport?" (in Russian) and Josh responds, after a long pause, "I have 15 dollars…" (in Russian) and Natalie responds, "oh, okay, you're good." (in Russian). The class is now roaring with laughter, the instructor clapping her hands and congratulating them in Russian and English, "bravo! Well done!"

In this situation, the exercise was very tense for everyone, especially those students singled out, but nervous laughter ultimately resulted in genuine joy. Furthermore, the joke – that Josh, without a passport, bribed Natalie in the scenario – was not apparently intentional and not understood by many students until other students informally explained and the instructor translated the exchange.

We observed a wealth of activities ranging from the highly scripted – reading a dialog from the textbook – to the almost completely unstructured – role-playing dinner guests in a restaurant. The middle ground, exemplified in the above improvisation activity, involved using word banks and sentence structure formulae to complete a role-play activity. Additionally, activities varied in the level of physical engagement, from movement and props to incorporating gestures and facial expressions in pair work.

During various theatrical activities, artifacts were used as media for creative expression, rather than for information and structure as in other kinds of activities. In these activities, artifacts provided students with common understanding of topic and protocol; the ability to look up a word or phrase not initially intended for the exercise, enabling creative expression; and the use of objects and gestures to disambiguate situations with unfamiliar words. In less scripted situations, students developed a cohesive scene and an entertaining scenario, using the surrounding objects and environment as a physical backdrop for their actions. These activities sometimes involved purposeful language use, such as in this example of a creative ending to a restaurant-themed role-play activity:

> Ben, playing a waiter, waves the instructor over, very secretively, and whispers a question about how to say a phrase in Russian (I hear because I am close). After he finds out, he runs up to the table, waving his hands frantically, and yelling in Russian that there is a FIRE IN THE KITCHEN! And, laughing, the students disperse and the exercise is over.

The emotional context of the classroom, including stress and joy, is important to consider when discussing the roles of objects. Artifacts were not sterile; they mediated complex social phenomena in an environment of uncertainty intertwined with camaraderie and humor.

Roles Played by Artifacts

Students and instructors made use of a variety of artifacts during class activities, such as textbooks, blackboards, photographs, and toys. These artifacts each had multiple and overlapping roles, which are summarized in Table 1, and described in more detail below.

Record

Notebooks were used by students to record information, although because of the fast pace of the class sessions, this was not frequent. One student, Michele, explained, "If something dramatic comes up I might write that down so I

Role	Description	Examples
Record	A more personal record of information for later use	Notebooks
Reference	Information referenced on-demand during activities	Textbooks
Structure	Provides a pattern or structure for activities	Scripts in textbook, fill-in-the-blank worksheets
Illustration	Used by the speaker to show others what they mean	Blackboards, slides, photographs
Prop	An artifact that is embedded in a role-playing activity	Worksheet used as menu in restaurant role-play

Table 1. Major roles played by artifacts in language classrooms

have it in the future. But mainly, I just speak." While recording in notebooks was infrequent, almost all students brought their notebooks to class every day.

Because of the fast pace of the classes, students rarely take notes during class. Instead, they focus their attention during class time on interacting with their peers and the instructor. Another student, Jenna, also noted the importance of the *ability* to write something down when needed, "I always have [my notebook] open just in case. I'll write little random notes," specifying that she would mostly only write something down "if it's something that wouldn't be in the textbook." We saw a few examples of this:

> Kelly interjects in English, asking a grammar question, about the effect of "in" vs. "at" on the case of the modified noun. The instructor pauses, and then suggests that Kelly picture relationships, and Kelly asks again, "I still don't know what it's supposed to be." The instructor responds by gesturing out some examples of containers and things in and at them, all in Russian. A handful of students seem to frantically be writing things down.

Because there is no warning or expectation of the need to record information, notebooks were simultaneously always present but rarely used.

Reference

Students and instructors often used artifacts as reference materials: most often the textbook, but sometimes other artifacts such as the blackboard or slides, which formed a common ground for collaborative learning [3]. These resources were used during conversations in Russian or when answering questions as on-demand information sources to help resolve a memory lapse or to prove a point.

Jenna sees the textbook as a comfort during class, especially when the instructor decides to "pick on" a student: "I know exactly where I could find the meaning of specific words, if I don't remember what it is." On several occasions the removal of textbooks, and their potential helpfulness, led to a sense of chaos and panic in the students, such as in this incident from the evening section:

> The instructor tells Mary, Max, and Ben they are limited in how much they can use the book in a dialog. They look terrified, their mouths agape, suddenly clutching their books with their hands, almost moving to close them or put them away but not. They are silent for a few moments, looking at their books and the instructor. [The activity begins; it's Mary's turn.] Mary chuckles and says, without looking into the book, "oh my gosh, this is horrible, I'm not *this* bad."

Here, the reference role is associated with emotional importance, assuring and supporting students. Even though they had only been referring to the books occasionally before this change to the exercise, the removal of the book apparently prompted self-consciousness.

Structure

Several artifacts, including the textbook, worksheets, and printouts, were used almost every day to structure activities

in the classroom. Students would often pair off and read scripted dialogs from the textbook, or do question-and-answer exercises with their neighbors to fill in blanks on a worksheet. One of the most common exercises involved students working in pairs of groups of three, reading dialogs from the book, or taking turns with question-and-answer exercises. Other exercises use the book or handouts as scripts for dialogs. Not all of these are familiar and rote to the students:

> The instructor hands out worksheets and divides the room into the "guest*s*," played by three students, and the "waiter*s*," played by three others. There is some confusion: "so is this like a chorus so we say at the same time?" asks one of the students. They agree that it is, and so that student counts off for his team – 1, 2, 3… and the three of them speak in a unison the line that is written for a single guest character. The two teams dialogue, giggling and occasionally sounding obviously intentionally robotic. At one point one of the teams talk about "I" and everyone, including *the instructor*, laugh*s*. The confusion persists, as another student asks: "dude… we're not one person…" The first student clarifies: "yes we are, we're speaking as a chorus. It's very weird." Laughing, they continue.

Although this exercise is technically very similar to typical dialog reading, the social aspects of the interaction seem to encourage a joyful camaraderie, where students are more willing to make jokes, sometimes in Russian:

> The script had been about getting a meal at a restaurant. When they come to the part about the bill, which turns out to be for 400$, Justin jokes: "oh my god, 400?" and then in Russian: "давайте удерать" (come on let's run!) There is laughter and another student frowns, commenting in English "what did we even eat? [Looks up in the script.] Pizza and vodka? That's… disgusting."

Illustration

Several artifacts were used by instructors to illustrate points or provide examples during lectures, including the blackboard, slides, and other materials like photographs. Students also used artifacts as illustrations, as in the following group exercise:

> The leaders [students] hold up the half-sheet-sized cards with photographic images of vegetables and ask their other two teammates, in Russian, "what did you buy?" and they are supposed to answer "you bought __" in Russian, and the leader replies "yes/no." They then go on with a series of questions, issued apparently wihout order, like "do you like [the food item]?" and "how much ___ did you get?" and so on, all in Russian, with the leader answering the questions.

These cards were passed out to students in small folders, pictured in Figure 2. In another class, another vegetable-name-related activity involved actual plastic vegetable props, also pictured in Figure 2. In both cases, the artifacts were used as illustrations, providing context for communicating in Russian. Pictures and objects were used not only to denote specific words, but to structure the conversation. The two types of artifacts pictured had different affordances, however. The images were used in a

more open-ended discussion about vegetables, as in the above quote. The props were used to communicate the vegetables' relation to one another on the table or the dishes ("the asparagus is in the glass," and so on), and to provide imperative commands to peers ("place the apple on the napkin, please"). Illustration artifacts not only informed conversation content, but afforded particular protocols.

Prop
An artifact is used as a prop when it plays a part in a role-playing or theatrical activity. We observed everything from textbooks to plastic food used as a prop over the course of the study. In many cases, artifacts used as props bore only a faint resemblance to the item they stood for in the activity. For example, the students use worksheets as props while role-playing ordering food at a restaurant:

> Andrey, the 'waiter,' asks for two 'guest' students' orders, and, as they tell him, writes them down on his worksheet and reads them back. They look up at each other like they are in a restaurant; consulting the worksheets like a menu and a little order pad, respectively.

Figure 3 illustrated the setting of this particular activity. As it unfolded, however, additional artifacts besides those clearly intended as props began to be used as props, such as textbooks and worksheets, as described in the quote above. A great range of objects were used as props, and in some cases, props were entirely imaginary, consisting of gestures, such as in this restaurant-themed exercise:

> As she is speaking, Amy turns, walks, gestures, and intonates, at one point pretending to hand one of the others an imaginary glass of water. Her team members giggle and also seem to be enjoying themselves as they order their food, looking up at Amy after ordering. She looks into the book occasionally after asking questions, but intently staring down when taking the order.

Here, Amy appropriates the textbook as a prop, and uses gestures to supplement her acting. Not all students are as open to resourceful role-play in class themselves, but those who are, are greeted, like Amy, with joy.

Artifact-mediated corrective feedback
Student-student corrective feedback was one of the most prevalent and important forms of student interaction that we observed in the language classrooms. Lyster & Ranta have categorized different kinds of corrective feedback, and analyzed its effectiveness in immersive, communicative language-learning classrooms [9]. We saw students regularly correcting one another, particularly when working in small groups:

> Nicholas speaks a Russian question quickly while looking into the book. Frank speaks an answer in Russian, also looking down. Nicholas repeats a word Frank had said, after a pause, correcting him: "*нужна*" and Frank nods, echoing: "yeah, *нужна*."

Lyster & Ranta define *recasting* as the situation when the instructor provides a correct form of a word or phrase. The nod and repetition of the correction on Frank's behalf is

consistent with a method of *learner uptake* described by Lyster & Ranta.

Occasionally, some implicit negotiation takes place prior to a corrective event, which is not a phenomenon reported by Lyster & Ranta. A student can seem to invite others to give a correction, by pausing frequently, looking up at the other student in the conversation, and using a questioning intonation. For example, in this case, Mary and Andrey had previously talked at length about a particular sound ("*ль*," a soft "*l*") with which Mary was struggling, but Andrey, who had prior experience with Russian, was relatively comfortable with:

> Mary is hesitantly and with a questioning inflection saying, rapidly looking at her book and at Andrey, "*нормально*?" (means "normal"/"fine," as in "neither hot nor cold"). This word includes the problematic "*ль*," and she gets it wrong again. Andrey nods, and repeats, correctly, "*нормально*." Mary nods and moves on to the next sentence.

Figure 2. Examples of illustration artifacts, associated with shared knowledge of activity protocol and providing a commonly-understood backdrop for practicing Russian. Above: folder with printouts of photographs of vegetables. Below: plastic vegetables. Both were used to practice saying phrases about food, but with different affordances.

The process of negotiation is subtle and error-prone. As we found through our interviews, unwelcome or excessive corrections can be annoying. One student we spoke to, Lane, also said that corrections "just stick with me," making them particularly helpful in the future. Although any student can correct any other student, it seemed that students from a Russian background in the classes made a disproportionate amount of corrections, which was annoying to several of our interviewees, such as Jenna:

> This was in last quarter where there was a lot of native Russian speakers, and I had sat by this boy who knew a lot of Russian and he would always correct me, always kind of nitpick on things I said, and I didn't really like that […] And I felt like—he was completely trying to help me, I understand that, but, yeah.
>
> —Jenna

In some cases, it seemed that attempts at peer correction, especially recasting, were downright ignored:

> Lee has trouble pronouncing the problem word from before, "*блюдце*:" "blue…. boo… bood…" and so on, making a series of false starts. Jusin says "*блюдце*" but Lee continues apparently oblivious and keeps going with a bunch more false starts until the instructor says it and repeats with him a few more times.

In the many instances of correction we noticed, however, it was often solicited, and resulted in the student being corrected incorporating the suggestion in some way into their speech. On the occasions when the corrections were not appropriate or accurate, the instructors quickly intervened and corrected both students.

In our observations, the occasional activities that involved all students writing on the board together in pairs or even individually were associated with a great deal of discussion in both Russian and English, often with the textbook acting as proof one could point to:

> Most students in pairs are turned toward each other, deliberating; they are peering into their own books, as they gesture around them. For a short time, two pairs of students seem to coalesce into one group, standing in a circle waving their arms and pointing at their books; their deliberation seems heated, but is eventually resolved.

The high frequency of students, rather than instructors, giving corrective feedback was surprising in light of the existing work, and illuminating in demonstrating the potential of different activity modes and artifacts to produce a stimulating environment for this type of collaborative student learning, such as by increasing students' confidence to correct one another. Jenna commented that:

> If I saw a mistake on the board, I'd be more likely to correct it on the board, than correct it through just a dialog. So I guess it might be more beneficial to have it written down … rather than speaking.
>
> —*Jenna*

Figure 3. A desk converted into a restaurant table for role-play.

In support of corrective feedback, artifacts helped to provide evidence as peers suggested alternative grammar, vocabulary, and pronunciation. This was especially important for non-heritage-speaker students. Using the whiteboard or worksheets for recording information during more informative lecture-style sections of class allowed students something to rely on for immediately-relevant knowledge they may not have remembered. Similarly, the tangibility of using the board for illustrating corrections, such as pictured in Figure 4, or using the book as a reference to prior material provided additional evidence to enable and encourage students to engage in peer-correction.

IMPLICATIONS FOR DESIGN

The findings of our study suggest a variety of opportunities and challenges for technology in the introductory communicative language classroom to address unmet needs, including (1) feedback: small group activities are an integral part of learning, but the instructor cannot be present to provide feedback by each group all the time; and (2)
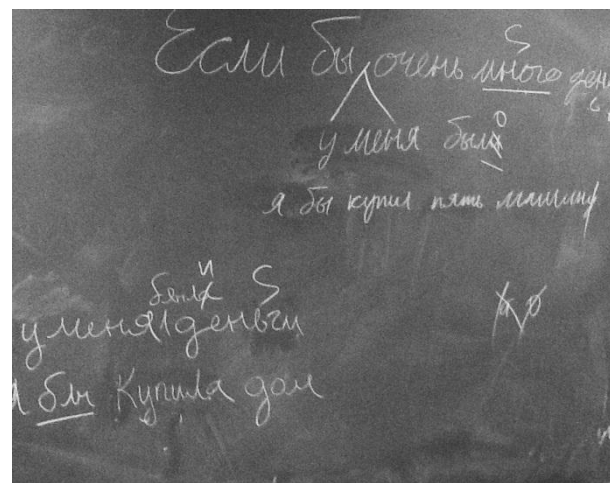

Figure 4. Students in pairs or small groups write on the whiteboard as part of some activities, correcting one another and consulting textbooks, as the instructor walks around and provides additional feedback.

engagement with authentic materials written by and for native speakers. The hope of technology in better supporting in-classroom foreign language learning has largely been left unrealized. Therefore, the following discussion focuses on how new technological artifacts might more effectively augment the existing ecology n such a classroom. In an environment where many artifacts compete for physical space and cognitive attention, the design of a new artifact must take advantage of the unique affordances not available in existing artifacts, such as to maintain more meaningful ambience or support multiple different roles.

In the following sections, we discuss how technology can benefit three phenomena in particular – feedback, use of the first language, and theatrical creativity. Feedback and concern with first-language use as balanced against authentic engagement reflect major recognized CALL needs [1]; focus on artifact-mediated creativity is presented as a novel design direction in this space. The discussion focuses on function of potential technology, rather than its form. There is a spectrum of possible physical objects, from a single shared artifact (*e.g.*, smartboard) to individual artifacts (*e.g.,* a tablet for each student). In the non-digital artifacts we saw used, there were objects used by individuals, small groups, and the entire class. Those functionalities that concern reference or record roles would best be served by individual objects, while illustration benefits more from a class-wide, shared object. While, props and structuring artifacts may take on any form, small-group artifacts were associated with the most engagement. Jamil et al, found that, relative to other similar mechanisms for group interaction, interacting with objects on a shared tabletop encourages the most direct group interaction [10].

Negotiated feedback as a process

One of our key discoveries was the prevalence of corrective feedback, especially correction by example, enacted by both students and instructors, as well as the absence of judgment-based "right or wrong" feedback. Furthermore, this feedback was associated with the use of reference materials to check the right answer, by either the giver or the receiver.

In addition to taking advantage of the possibilities of electronic media, we can better contextualize the information that is provided by artifacts. Textbooks, for example, provide a contextualized version of a vocabulary list by including an abridged list at the end of each chapter, rather than only providing a dictionary in the back of the book. Interactive applications and devices can provide streamlined access to words and rules. This could be based on flashcard principles, such as the context-sensitive MicroMandarin mobile application [11]. Furthermore, rather that revealing information all at once, reference artifacts could allow partial access: in existing language-learning applications, drilling tools already rely on an

iterative process of increasing difficulty [1], which could scaffold nuanced social negotiation of difficult concepts.

Besides reference to the book, the record of a class can act as a backdrop for student-student feedback. For instance, the Conversation Clusters system provides meeting archive functionality for collocated meetings by maintaining searchable topic clusters based on speech recognition and interaction with meeting members during the meeting [12]. Although the off-the-shelf speech recognition system used is not perfect, it is real-time, and its errors are mitigated by enabling users to edit the output. Mimicking human memory, Bergstrom and Karahalios maintain a record only of key terms whose utterance the speech recognition system was sure of. As these terms are recognized in real time, they are presented in clusters in a "public conversation space." This space allows people not only to remove wrongly recognized terms, but to move terms across different clusters, which are initially constructed using existing technology. This visualization method provides a current snapshot of the conversation topics, and is complemented by a history view. Given the verbal and spontaneous nature of the classrooms, this type of record-keeping technology could be appropriate.

One of the most discouraged means of communicating in the first language that we saw was commiseration and reflection on the frustration and anxiety of the busy and challenging classrooms. This type of communication seemed important to the development of a group identity as a class among students. Besides looking up the right answer or being corrected for being wrong, simply expressing frustration or joy may be a powerful social tool. For example, the Subtle Stone device provides a flexible, private method of using a small lighted sphere for allowing the students to communicate to the teacher whether they were bored, happy, frustrated and so on [13]. The authors note that though privacy was important, some students thought it may be worthwhile to use the device as a means of student-student communication.

Authenticity vs. metalinguistic discussion

A variety of Natural-Language Processing (NLP) technologies may be salient to the language-learning classroom, including speech recognition, handwriting recognition, semantic analysis, machine translation, and so on. In existing Computer-Assisted Language Learning (CALL) applications, various methods of evaluating low-level sentence structures via parsing and so on dominate the space of NLP-enabled applications, within and beyond the classroom [1] [14]. These tools seem promising in providing more interactive support in language learning. Some recent work in incorporating NLP in CALL applications has considered the value of interactive learning, where the underlying NLP system changes its behavior based on interaction with the user (*e.g.,* [14]).

Machine translation could bring authentic materials within reach of beginners. Koehn showed that visually supporting

interaction with machine translation output can enable individuals who do not speak the source language, but are familiar with the target language and topic, can fix errors in translations as well as bilingual speakers [15]. Interaction with translation could be used as a way of giving beginning students exposure to authentic text.

Automatic speech recognition (ASR) is a promising tool for pervasive technology to augment a language-learning classroom. However, the state of the art of ASR is pushed to its limit in noisy environments, with learners making atypical errors, from the perspective of systems trained with native speaker data. Such barriers prevent widespread adoption [1]. Moreover, the use of the first language – in our case, English – cannot be ignored. Despite potential efforts to the contrary, it is inherent in learners and has potential benefits from the pedagogical perspective [8]. If a device or application that incorporates NLP technologies is to be integrated into a classroom, it must be designed with the awareness that switching between languages can and will occur.

Consider this typical scenario, where reading aloud from a book is punctuated by interruptions, switching between languages, and laughter, brewing a nightmare for speech recognition software:

> At one point, Jake is reading the Russian aloud and says "17" in English, evidently by accident, as he immediately laughs and covers his face, while everyone else laughs, as well. Jake apologizes, grinning, and repeats "17," this time in Russian, and keeps going with the reading.

In transferring existing applications into the social multilingual environment, we must be aware of the limitations and leverage as much as possible human involvement. One example of such an application is AwkChecker, a real-time text editor that provides feedback on how common certain phrasings are in order to enable students of a language to get a better sense of how natural what they write sounds [16]. Park, et al, show this kind of feedback to be very useful. In the classrooms observed, students discussed how to phrase certain statements; an application like AwkChecker in the social context would require, for example, functionality for resolving "which is better" disputes. The design of NLP-based systems must acknowledge that readily available technologies are often inappropriate here, but that experimental, specialized technologies hold great potential.

Joy, creativity, and props

The theatrical activities we observed provide a particularly rich opportunity for the design of interactive devices, including opportunities for tangible props and intelligent dialogs. Though sometimes the instructors brought props, such as toys, plastic food, or dinner wares, the role of a prop was more often emergent and imposed on nearby objects, *e.g.* a piece of clothing, or the textbook, which most were already holding. Props need not be of very high fidelity in order to be used to illustrate ideas, make jokes,

and otherwise engage more fully with a role-playing scenario. Flexibility and speed are more important than photorealism, so there are possible opportunities for applications that enable quick sketching (*e.g.*, [17]), or perhaps object lookup from photo-sharing services (*e.g.,* flickr.com).

Tools for engaging students in joyful, creative interaction benefit from being on shared devices, rather than individual ones. In our observations, reading scripts from textbooks seemed to be associated with far less spontaneous interaction or communication, and rather with physical isolation into the books. One of the main activities that took place in the classroom was the reading of a scripted dialog, using a suggested bank of phrases or words, or constructing a scenario using formulaic sentences. Devices and applications within a classroom have the capacity for enabling intelligent dialogs that are continually tailored to users' progress and proficiency. In considering the design of such interventions, it is critical to become immersed in language teaching and learning literature as well as to work directly with instructors, because there is risk of such a device changing the dynamic of the classroom and interfering with instruction.

CONCLUSIONS AND FUTURE WORK

Based on a two-month ethnographic study of three introductory Russian classrooms involving observations and interviews, we have characterized a variety of roles currently played by artifacts: record, reference, structure, illustration, and prop. Objects in the classroom can take on more than one role, and each role supports communicative language teaching [2] and mediating collaborative knowledge building [3]. We also contributed a discussion of specific technologies that could help learners within the classroom, taking on one or more role and supporting the breadth of social interaction. We discussed the manifestation of stress and anxiety, as well as joy and humor in the classroom and its implications for the design of classroom technologies. In light of our findings, we presented implications for design in this space:

Feedback as a negotiated process, not event: A key benefit of technology for education is to help more effectively redistribute the teacher's time, such as by providing automatic feedback where possible (*eg,* [4]). Technology that can accomplish this is very different in the social, rather than individual, context. Negotiated feedback from peers, using repetition and correction as a signal, was an important aspect of the classroom, and technology that provides feedback could benefit greatly from similar minimally intrusive, example-based approaches.

Authenticity vs. metalinguistic discussion: To support multilingual interaction, technology must balance authenticity and use of the foreign language against the need to use the first language for metalinguistic discussion. In the cases where technologies such as

speech recognition are used, it is crucial to keep in mind that there are at least two languages used in the introductory classroom.

Joy, creativity, and props: To support creative and entertaining role-play, technological artifacts should be shared within small groups, and enable open-ended activities. This can either mean rapid image look-up or sketching, or dynamic, interactive dialogues that support engagement over more scripted exercises.

Additional ethnographic studies of classrooms, as well as exploring student interactions beyond the classroom, can provide much-needed empirical grounding for our understanding of how students interact to learn new languages, and how physical artifacts can support that process. Interviews with students provided invaluable perspectives on the meanings of artifacts and processes, and focusing more on these individual perspectives in future studies will provide richer and more nuanced understanding. More advanced classes and classes in other languages must be studied, as student motivations and relationships are different. For example, in an English as a Foreign Language (EFL) classroom, there is often no shared first language. Considering the importance of first language in our findings, studying EFL classrooms will likely shed new light on student-student communication. Finally, the development and deployment of devices and software for in-classroom use to help language learners, and qualitative and quantitative study of their performance, is crucial. There are many opportunities for technology to support foreign language learners, as well as challenges for designing artifacts that complement this environment.

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REFERENCES

[1] N. Garrett, "Computer-Assisted Language Learning Trends and Issues Revisited: Integrating Innovation," *The Modern Language Jounral,* 2009.

[2] S. J. Savignon, "Communicative Language Teaching: Linguistic Theory and Classroom Practice," in *Interpreting Communicative Language Teaching*, 2002.

[3] G. Stahl, "Building Collaborative Knowing," in *What We Know About CSCL*, 2004.

[4] D. Musumeci, "The Use of Technology in High-Enrollment Courses: Implications for Teacher Education and Communicative Language Teaching,"

in *Interpreting Communicative Language Teaching*, 2002.

[5] S. Bax, "CALL - past, present, and future," *System,* 2003.

[6] K. Charmaz, Constructing Grounded Theory, 2005.

[7] R. M. Emerson, R. I. Fretz and L. L. Shaw, "Writing ethnographic fieldnotes," 1995.

[8] V. Cook, "Using the First Language in the Classroom," in *The Canadian Modern Language Review*, 2001.

[9] R. Lyster and L. Ranta, "Corrective feedback and learner uptake: negotiation of form in communicative classrooms," in *Studies in second language acquisition*, 1997.

[10] I. Jamil, K. O'Hara, M. Perry, A. Karnik and S. Subramanian, "The Effects of Interaction Techniques on Talk Patterns in Collaborative Peer Learning around Interactive Tables," in *CHI*, 2011.

[11] D. Edge, E. Searle, K. Chiu, J. Zhap and J. A. Landay, "MicroMandarin: mobile language learnign in context," in *CHI*, 2011.

[12] T. Bergstrom and K. Karahalios, "Conversation Clusters: Grouping Conversation Topics trhough Human-Computer Dialog.," in *CHI*, 2009.

[13] M. Balaam, G. Fitzpatrick, J. Good and R. Luckin, "Exploring affective technologies for the classroom with subtle stone," in *CHI*, 2010.

[14] C. Greene, K. Keogh, T. Koller, J. Wagner, M. Ward and J. van Genabith, "Using NLP Technology in CALL," in *STIL/UCALL*, 2004.

[15] P. Koehn, "Enabling Monolingual Translators: Post-Editing vs. Options," in *ACL*, 2010.

[16] T. Park, E. Lank, P. Poupart and M. Terry, ""In the Sky Pure Today?" AwkChecker: An Assistive Tool for Detecting and Correcting Collocation Errors," in *UIST*, 2008.

[17] A. M. Piper, N. Weibel and J. D. Hollan, "A Pen-Based Toolkit for Authoring Collaborative Language Activities," in *CSCW (demos)*, 2012.

[18] O. Kagan and K. Dillon, "A New Perspective on Teaching Russian: Focus on the Heritage Learner.," *The Slavic and East European Journal,* 2001.