

QUICK RESPONSE (QR) CODES FOR AUDIO SUPPORT

IN FOREIGN LANGUAGE LEARNING

KATHLEEN MURRAY VIGIL

Boston University School of Education, 2017

Major Professor: Bruce Fraser, Ph.D., Professor Emeritus of Linguistics and Education

ABSTRACT

This study explored the potential benefits and barriers of using quick response (QR) codes as a means by which to provide audio materials to middle-school students learning Spanish as a foreign language.

Eleven teachers of Spanish to middle-school students created transmedia materials containing QR codes linking to audio resources. Students accessed the audio tracks by scanning the QR code with an application on a smartphone while completing a homework task. The teachers assigned two tasks in a systems approach model: first a formative, and then a revised summative trial. After each attempt, the Spanish teachers shared their experiences of creating and using the transmedia materials by participating in interviews.

Data was collected by means of a needs analysis survey, recordings and transcription of the two interviews, and by obtaining copies of the transmedia materials. The data analysis included a content analysis of the coded interviews, the results of which were triangulated with the responses collected in the needs analysis survey and an examination of the teacher-created materials.

Several benefits to using audio QR codes were identified as a result of the

analyses. These include the minimal amount of time and expertise required for teachers to create the transmedia materials, an increased student exposure to audio-only materials to aid listening comprehension, and the way in which the use of this technique allowed for transformative learning activities and a conservation of instructional minutes in the classroom. Some barriers were also noted, the largest being that device ownership and Internet access were not universal among students. Additionally, parental restrictions on smartphone use and some school administration policies regarding personal devices made the practice of using mobile technology for homework tasks difficult in certain cases.

Implications include the possibility that training pre-service and in-service teachers in the use of transmedia materials that link to audio-only content may help decrease students' cognitive load and lead to an increase in foreign language learners' listening comprehension skills. Further study in the use of transmedia materials and mobile technology to support foreign language learning is recommended.

TABLE OF CONTENTS

ABSTRACT.....	iv
TABLE OF CONTENTS.....	vi
LIST OF TABLES.....	vii
LIST OF FIGURES.....	viii
LIST OF ABBREVIATIONS.....	ix
GLOSSARY.....	x
CHAPTER ONE.....	12
Need for Competency in Foreign Languages.....	12
Listening Comprehension in Foreign Language Acquisition.....	12
Listening Comprehension with Prepared Audio Materials for Homework.....	13
Mobile-Assisted Language Learning (MALL).....	14
QR Codes.....	15
Transmedia Approach in Learning Contexts.....	16
Problem Statement.....	17
Purpose.....	19
Context.....	20
Research Question.....	22
Significance of the Study.....	22
Researcher Qualifications.....	23
Conclusion.....	24

LIST OF TABLES

Table 1: <i>Systems Approach Model</i> (Dick, Carey, and Carey, 2008) and modification	47
Table 2: Data analysis for study.....	66
Table 3: Needs analysis categories and corresponding questions	75
Table 4: Importance of listening comprehension skills	87
Table 5: Current ways of providing audio examples	90
Table 6: Major themes and codes from interview data.....	93
Table 7: Application, adaptation, and novel use of audio QR codes in materials	137
Table 8: Importance of listening comprehension skills from needs analysis	139
Table 9: Content and purpose of listening comprehension homework with audio QR codes	141–143
Table 10: Technical specifications of audio QR codes.....	145
Table 11: Number of audio QR codes per worksheet for formative and final activities .	146
Table 12: Ertmer’s (1999) <i>Barriers to Technology Use</i> aligned with the results of the audio QR code study.....	161–162

LIST OF FIGURES

Figure 1. Quick response code.....	5
Figure 2. Ertmer’s <i>Barriers to Technology Adoption</i>	8
Figure 3: Modified instructional <i>Systems Design</i> approach	11
Figure 4: Sensory input received by auditory and visual channels	24
Figure 5: 1D and 2D bar codes	33
Figure 6: Options for linking to content when creating QR codes	34
Figure 7: Puentedura’s <i>SAMR Model of Technology Adoption</i>	44
Figure 8: Phases of the study	51
Figure 9: Flowchart for professional development training	55
Figure 10: Vocaroo web-based media player	116
Figure 11: Summary of benefits and barriers to audio QR materials	152
Figure 12: Implementing transmedia in educational settings	172

LIST OF ABBREVIATIONS

ACTFL	American Council on the Teaching of Foreign Languages
CALL	computer-assisted language learning
CLT	Cognitive Load Theory
FL	foreign language
L1 or L2	first or second language
MALL	Mobile-Assisted Language Learning
.mp3	audio file type/extension
QR	quick response
SAM	Systems Approach Model
SAMR	Substitution, Augmentation, Modification, and Redefinition
TPACK	technological and pedagogical content knowledge
Wi-fi	wireless high-speed Internet connectivity

GLOSSARY

Cognitive load – Sweller’s (1988) description of the amount of mental effort being used at a given time in the working memory to process information

Multi-media – the use or combination of a variety of media, including but not limited to audio, video, graphics, and online simulations

Mobile technologies – any device that can be easily transported and allows for access to information. Common examples include smart cellular phones, and tablets or application-ready devices (e.g. iPod) that connect to the Internet via wi-fi

Quick Response (QR) Codes – a two-dimensional bar code that can be scanned by a device containing a QR reader and camera to reveal information in a variety of formats (plain text, images, links to web sites, audio files, contact information, etc.)

SAM – the Systems Approach Model developed by Dick, Dick and Carey (1978) which is used by instructional designers to inform the use of new methods or procedures in a learning environment. Steps in the SAM include identifying goals, writing objectives, developing instructional strategies, completing formative and summative trials of the strategy, and conducting an analysis based on the results.

SAMR – the Substitution, Augmentation, Modification, and Redefinition model from Puentadura (2010) that can be used as a framework for evaluating the way in which technology is used in educational settings

Smartphone – a cellular phone that can also be used to access to the Internet, with the ability to download and run various applications to replicate some of the functionality of a computer

TPACK – Technological Pedagogical Content Knowledge, which can be explained as a teacher’s knowledge of not only the subject matter to be taught, paired with an understanding of the best ways in which to teach it and how technology can support these instructional strategies

Transmedia materials – in the context of education, these are materials that allow the learner to easily move from one medium to another (print, audio, video, etc.) in order to support learning

CHAPTER ONE

Introduction and Overview

Need for Competency in Foreign Languages

According to the National Council of State Supervisors for Languages (NCSSFL), twenty-five states currently either require or recommend that students enroll in foreign language courses in high school in order to qualify for graduation, college admission, advanced diplomas, or scholarships (NCSSFL, 2012). The need for competency in a second language is also often cited as a necessary ‘21st century skill’ for graduates entering a job market in a more interconnected, global economy (Kay, 2010; Lemke, 2010). The growing number of schools offering non-traditional foreign languages, such as Mandarin and Arabic, verifies an increasing awareness by educators that knowledge of a foreign language is a practical, modern literacy skill that is valued in candidates hoping to find employment in fields such as business and politics (Abu-Melhim, 2014; Tsung & Cruickshank, 2010). Educational policy makers are under increasing pressure to help move the United States away from its ‘monolinguist’ practices, both to ensure the competitiveness of American students with bi- and tri-lingual international graduates, and to facilitate communication within a linguistically diverse domestic population (Met, 2008).

Listening Comprehension in Foreign Language Acquisition

Modern organizations centered on best professional practices for foreign language instruction, including the American Council on the Teaching of Foreign Languages (ACTFL), recognize the importance of providing auditory and visual linguistic input to learners, including samples of the target language both in oral and video format through the use of new technologies such as the Internet, podcasts, and mobile phones (ACTFL, 2015, p.20). Some educational

theorists (Mousavi, Low & Sweller, 1995) and leaders in the field of multi-media design for educational purposes (Clark & Mayer, 2008) argue that there are benefits to presenting audio materials separately from visual resources (i.e. still images and video) in order to decrease ‘cognitive load’ and better allow information to be processed from the working memory to the long-term memory. While images can enhance conceptual understanding of topics, audio-only listening comprehension activities may better help the learner distinguish the discrete sounds of the target language without distractions or interference from the visual channel (Vredeveltdt, 2011; Rahmatian, 2011). Teachers of foreign languages who wish to incorporate audio listening activities into their teaching apart from live readings during class time, however, have traditionally faced several obstacles to their regular use. These include the availability of materials that are a match with the curriculum and ability level of the learners, access (both in and out of the classroom) to technology on which to record and play the audio files, and the time and technological expertise required to create original audio examples and exercises (Godwin-Jones, 2013; Mathew & Alidmat, 2013).

Listening Comprehension with Prepared Audio Materials for Homework

The increasing emphasis over the past ten years on data-driven instruction and standardized testing to provide evidence of accountability in meeting state standards has added to the pressure on educators to use face-to-face instructional minutes as efficiently as possible (Kronholz, 2012). Foreign language teachers who seek to increase students’ listening comprehension skills, but still preserve instructional minutes for communicative activities, may choose to assign homework tasks in which students can hear and decode auditory examples of the foreign language. As is the case with other school subjects, studies on the benefits of homework in foreign language settings have shown mixed results in terms of impact on

academic achievement (Kohn, 2007; Chang, et al., 2014, Wallinger, 2000). Homework completion in foreign language settings has, however, been positively linked to increases in student motivation to learn the new language, with the provision that students must feel that they are making efficient use of short periods of time outside of school (Chang, et al., 2014; Bempechat, 2004; Epstein & Van Voorhis, 2001). Creating the homework tasks should also be practical for teachers, as these are considered to be an instructional ‘supplement,’ with the awareness that not all students will put forth the same effort into completing these tasks outside of the classroom (Wallinger, 2000). In summary, homework involving foreign language listening comprehension activities should be relatively easy for the teacher to create and disseminate, and must be easily and quickly accessible to students outside of the classroom. Until recent improvements in audio-authoring solutions and the rapid growth in ownership of mobile technologies (Anderson, 2015), creating homework tasks that involved the use of audio samples and exercises was prohibitive in terms of both the preparation time and expertise required by the teacher, and the limited ability for students to access the audio samples outside of the classroom (Gomez Martinez, 2010).

Mobile-Assisted Language Learning (MALL)

Advances in educational technologies have led to solutions involving hardware and software that can simplify the creation of, and access to, digital audio materials for listening comprehension activities. The evolution from (1) school-based ‘language labs’ with audio cassettes to (2) computer-assisted language learning (CALL) models through desktop computers and specialized software has now (3) entered a third phase in which students can use their own personal mobile devices (tablets or ‘smartphones’) and Internet-based applications to practice the target language (Otto & Pusack, 2009). An annotated bibliography of several hundred studies on

mobile-assisted language learning (MALL) use in language learning settings over the past 20 years showed that students are interested in accessing audio materials via mobile technology to support language learning outside of school (Burston, 2013). Despite the stated openness to the new technology, however, student use of the audio content was not universal (in some cases as low as 40%), and there was a distinct preference for using shorter audio activities, as predicted in the studies of homework above (Chang, et al., 2014; Bempechat, 2004; Epstein & Van Voorhis, 2001). In spite of the increasing numbers of students with home access to Internet-connected personal mobile devices that have the ability to access and play audio clips (Anderson, 2015), there is little evidence that teachers of foreign languages are regularly creating audio materials for student use on mobile technologies (Morin, 2007).

QR Codes

One method which teachers of foreign languages might use to facilitate the creation and distribution of audio resources is a quick response (QR) code. A QR code is a two-dimensional barcode in the form of an image comprised of small black and white squares (see Figure 1).



Figure 1: Quick response code

Unlike UPC codes, QR codes encrypt information in both vertical and horizontal directions, thereby having the ability to display more than 1000 ‘characters’ that can store up to several pages of information (Lai, et. al, 2013, p. E58). These codes were originally developed in the

mid-1990's for use in automotive factories in Japan (Shin, 2012), but their use spread rapidly to the advertising industry.

There are several free web tools and mobile applications that allow users to create and track QR codes. Creating the code takes a matter of seconds; once the web link or content is entered into the web site interface, the QR code is automatically generated. It can then be saved in a digital image format and either printed onto paper or embedded into digital environments, such as word processing software or Internet pages.

In order to interpret the information hidden in the QR code, the user must install a QR code reader application on a mobile device, such as a smartphone or tablet, which contains a camera. After opening the application, the camera on the mobile device acts as scanner that 'reads' the QR code and interprets the binary patterns. QR codes can link to a URL leading to any type of web-hosted content, such as an informational site, video, image, or audio track. When a user scans the QR code with a smartphone camera, the application decodes the information and routes the user to a web address using the default browser installed on the device.

Common examples of QR codes outside the educational context include their use on tickets in the rail and airline industries, on food packaging to link to nutritional content or recipes, and in advertisements that route consumers to web-hosted content via a page in a newspaper or magazine. The adoption of QR codes into educational contexts, however, has been slow and limited in scope (Albastroiu & Felea, 2015; Hopkins, 2013).

Transmedia Approach in Learning Contexts

One possible use of QR codes in an educational setting is to have students scan a QR code on a paper worksheet in order to gain immediate access to accompanying digital resources

(Kamarainen, et al., 2013; Lai, et al., 2013). This process is called ‘transmedia navigation’ as users move seamlessly between print and digital resources (Cohen, et al., 2012; Leone & Leo, 2011). Baik (2012) describes this transmedia approach as providing students with an ‘analog portal to a digital world,’ and highlights the ease with which users can retrieve ‘multimedia messages’ on the Internet by scanning QR codes (p. 430). Learners can complete tasks that utilize transmedia resources both during instructional time in the classroom, and in other contexts such as on field trips, in the library, or at home.

Increased access to mobile technologies now makes this instructional method of linking students to multi-media resources more practical. Robin (2007) predicted that hardware technologies already in use by students in their everyday lives could be utilized for foreign language listening comprehension activities. He stated, “No longer are such devices part of the specialized landscape of the L2 learner; instead they make up the everyday L1 machine-mediated world of listening” (p. 109). As the majority of teens now own smartphones (Anderson, 2015) and can install free applications to scan QR codes, there is untapped potential for students to use these devices as learning tools during foreign language acquisition (Kolb, 2008).

Problem Statement

Students learning a foreign language need more time and exposure to audio examples of the target language, especially in the early stages of L2 acquisition when the formation of phonemic awareness and discrete listening skills are of critical importance (Caroll, 2007, as cited in Chan, 2010, p. 29; Vandergrift, 2007; Morin, 2007). Advancements in the functionality and availability of mobile technologies over the past ten years have opened up new means by which students can access audio materials for additional practice outside of the classroom; yet there is

little evidence to suggest that teachers of foreign languages are taking advantage of this option as a regular part of their teaching practice.

This reluctance on the part of teachers to create learning materials that use the multi-media functionality of mobile devices with applications such as QR codes may be due to any one or more of the following ‘incremental, fundamental, institutional, or personal’ barriers that Ertmer (1999) describes as interfering with the adoption of new technologies (p. 48):

Barriers to the Adoption of New Technologies	lack of awareness of the capabilities
	need for specialized training
	low self-efficacy in experimenting with new application
	outside constraints such as school or parental limitations
	concern for alignment with current pedagogical methods

Figure 2: Ertmer’s (1999) *Barriers to the Adoption of New Technologies*

With the rapid advancements in mobile hardware technology over the past 15 years and the subsequent development of thousands of software applications for use with these devices, it is unsurprising that teachers might not have been able to experiment with scanning technology. If teachers could be trained in the effective use of a simple and flexible technology like QR codes, all of the potential problems listed in the table above - except for ‘outside constraints’ - could be greatly reduced. This final barrier might also be overcome if the school administration and parents were convinced of the educational benefits of a new technology after witnessing its use.

Given the untapped potential of QR codes to facilitate the integration of digital and paper resources, the lack of research in this transmedia approach in K–12 foreign language settings, and the challenges of introducing new technologies to practicing teachers, this study was undertaken. The design centered on individually training a small number of middle-school Spanish teachers in the use of QR codes, in order to determine the barriers and benefits to this method of using QR codes for the delivery of digital audio content outside of the classroom that could enhance the teaching and learning of a foreign language.

Purpose

The purpose of this study was to investigate how feasible it is for middle school teachers of a foreign language to create and use QR codes that link to audio resources as a way to enhance learners' access to materials that may aid in the acquisition of listening comprehension proficiency.

Although QR codes have been successfully implemented in the business and marketing contexts since the early 1990's (Shin, Jung, & Chang, 2012), they are a relatively new pedagogical tool, so there are few studies regarding their use to help students access academic support materials. Some educators have studied the use of specific applications that are designed to be accessed via QR code, such as customized software to help students practice new skills in English (Liu, Tan, & Chu, 2010) or a game-like interface designed to work in conjunction with a science field trip experience (Kamarainen, et al., 2013). Others have focused on QR code use as a classroom activity in language arts or ESL contexts and found inconclusive results (Arikan & Ozen, 2015; Chen et al., 2011). Recommendations in the findings of several studies include a need for further investigation into the transmedia approach that allows for connection to audio supports (Law & So, 2010; Leahy, 2013; Crompton, LaFrance & van 't Hooft, 2012).

Context

This study involved the cooperation of eleven middle school teachers of Spanish as a foreign language. The research process followed a modified ‘instructional systems design model’ (Dick, Carey, & Carey, 2008) in which first the needs of the teachers and learners were established, and second this information was used as the basis for the design of the subsequent training on using QR codes to access audio materials. The study was conducted in four phases:

1. a needs analysis in which each of the teachers provided information about their teaching practices and context
2. a customized professional development training session in which the researcher met with the teachers individually to demonstrate the creation and use of the audio QR codes
3. a formative (preliminary) try by the teacher of the QR audio codes with the students after which the implementation was discussed with the researcher in order to reflect on the process and determine any needed adjustments
4. a final implementation by the teacher of a QR audio code activity with the students, which was followed by an interview designed to elicit the positive and negative features of this particular technology in the foreign language learning context



Figure 3: Modified *Instructional Systems Design* steps (Dick, Carey & Carey, 2008)

The results of the survey, in addition to informing to the design of the professional development, were analyzed to examine similarities and differences in learning contexts. Blank

copies of all materials that the teachers created and distributed to the students with audio QR codes were collected and compared both with the original templates that were offered as suggestions by the researcher, and also across classrooms to examine the different ways in which teachers used the QR codes to support listening comprehension. Transcripts of the interviews that took place after the formative and final trials of the QR activities were coded in order to facilitate a content analysis on the experience of the foreign language teachers when using this new technology. A full description of the methodology, including the data collection instruments, timeline, and analysis procedures, is included in Chapter 3.

Research Question

The question that guided this study was: What are the benefits and barriers to using Quick Response (QR) codes, that link to audio resources, as a means by which to support students' listening comprehension skills in the beginning stages of foreign language acquisition?

Significance of the Study

Discovering the most effective ways in which audio resources can be effectively accessed by learners outside of the classroom will inform the practice of current and pre-service teachers of modern foreign languages. The increased ability of teachers to develop and assign listening comprehension exercises as homework could allow them to devote more instructional minutes to communicative activities in the classroom that are essential to the development of oral proficiency. The findings may be generalizable to the teaching of foreign languages other than Spanish, and to learners at different stages of language acquisition. The analysis of the barriers and benefits to using QR codes as links to audio resources might also inform the practice of teachers of other school subjects interested in using this technology to create transmedia links to

Internet resources, such as video or online reference text to support learning in mathematics, language arts, science, or social studies.

The design of the study itself, with an educational technology specialist creating a customized training solution for a classroom teacher and providing encouragement and support during the initial implementation of the new tool was meant to serve as a model for effective K–12 professional development in the use of emerging technologies. The procedure for the introduction of the new technology, including the needs analysis, personalized training, and formative and final trials, can be reproduced by other researchers or instructional designers in different educational contexts.

Researcher Qualifications

The primary investigator for this study has interest and experience in both the use and instruction of educational technologies, as well as a background in foreign language instruction and acquisition. The PI is a learner of German, French, and Spanish as a foreign language, and Danish and Russian as a second language (in an environment where the language is spoken as the regular medium of communication), and has therefore experienced a variety of formal and informal methods for increasing listening comprehension skills, both in and out of a classroom setting. The PI has a Master's Degree in Cultural Diversity/Curriculum Reform, with a specialization in adult learners of English as a second language, and taught English as a foreign language in Russia for one year and ESL in a variety of contexts to older learners (ages 14–adult) for four years. The PI also taught an online course on language acquisition and development (40 versions over seven years) via the University of San Diego to practicing K–12 teachers in the state of California who were required to earn the Cross-Cultural, Language, and Academic Development (CLAD) certificate.

Since entering the field of instructional technology in 1997, the Primary Investigator has taught technology applications to students of all ages, including ten years of instruction for students in grades K–8. During this time teaching in public and private schools, the Primary Investigator was also responsible for mentoring colleagues in educational technologies, leading professional development workshops, and presenting at conferences. The PI then entered a doctoral program in Educational Media and Technology in 2007, and has been teaching college courses at the graduate and undergraduate levels in instructional technology to pre-service teachers since 2008.

This combination of a background in language learning and teaching, with a knowledge of best practices for instructional design, qualified the PI to perform the needs analysis, and then to design and deliver the professional development training to the in-service middle school Spanish teachers.

Conclusion

This chapter presented the rationale for conducting a study on the potential for a new technology to help foreign language teachers at the middle school level deliver audio content to students outside of the classroom for listening comprehension practice. The new technology of Quick Response (QR) codes was chosen as having the most potential to help teachers of foreign languages bridge the gap between paper and digital audio resources in what is known as a transmedia approach. Through a qualitative analysis of the collected data from the needs analysis survey, teacher-created materials, trainings, and interviews, the primary researcher hoped to elicit common benefits and barriers to using Quick Response (QR) codes that link to audio resources as a means by which to help grow students' listening skills in the beginning stages of foreign language acquisition.