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Articles

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汉语第二语言阅读者在上下文语境中的别字检测和复原效应 (Detection and Recovery Effects of Wrongly Written Characters in Context among Readers of Chinese as a Second Language)

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摘要：阅读过程是心理语言学研究的一个重要问题，不同学者对阅读中的加工与认知模型有着不同的见解。并且，别字在上下文语境中是否能被检测和复原也是中外学者研究的焦点，其中学界对语音、字形和语义之间的关系和作用也产生了不同的观点和分歧。研究阅读过程可以采取眼动实验的方式记录和分析阅读者真实的的认知过程。本研究通过探究以汉语作为第二语言的阅读者在上下文语境中是否发生别字的检测和复原效应，以及其中语音、字形发生的联结作用，对以上争论做进一步的探究和讨论。

因此，本文立足于联结主义模型之上，采取眼动实验的方法，针对汉字圈和非汉字圈不同语言背景、不同语言水平的汉语学习者，分析同音异形、同音形似、异音形似别字在正确语境中的识别速度，通过三个变量的综合分析，运用早期眼动指标（首次注视时间、凝视时间）和晚期眼动指标（总注视时间、回视路径时间、注视次数）来说明字形、语音与语义之间的识别先后及识别速度，并建立更具体化的联结主义模型。

研究结果表明，（1）别字所在整句与无别字整句之间各项眼动指标都无显著差异，因此认为别字可以被学习者顺畅阅读，即别字可被自动修复，完成词语及语句的理解。（2）汉字圈学习者与非汉字圈学习者无论语言水平，在别字的早期识别过程中，都呈现出字形与语义的强联结作用，但非汉字圈的汉字复原与检测效应更弱于汉字圈学习者。（3）在汉语阅读文本加工难度上，汉字圈学习者更善于加工异音形似别字，即形码与语义之间的联结更强；而非汉字圈学习者则更善于加工同音异形别字，即音码与语义之间的联结更强。（4）在别字认知过程的后期阶段，汉字圈学习者更依赖于字音与语义的转化，非汉字圈学习者则对音、形、音形结合的解码速度一致，表示非汉字圈更多注重于早期字形的解码作用。（5）母语者对音、形、义的识别模型中，字音、字形与音形结合的解码都是相同速度的，无一者处于主导地位。因此其认知结构为成熟语言者对汉语阅读的稳定结构。

综上所述，汉语作为第二语言学习者在阅读中确实产生别字的检

测和复原效应，并且不同语言背景，语言水平的学习者对汉字的识别有着不同表现，这对对外汉语教学中的汉字与词语教学有着重要的启示，教师可以从中汲取教学中可以改进的教学方法，汉语学习者可以据此采用更加科学有效的学习方法。

Abstract: Reading processes are an important issue in psycholinguistics. Scholars have different opinions about the processes and cognitive models involved in reading. Moreover, whether wrongly written Chinese characters can be detected and restored in context is also the focus of much research (among which the relationship and role of orthographic layers, phonological layers, and semantic layers also lead to different views and divergent opinions). With the support of modern science and technology, eye movement experiments can be used to record and analyze the actual cognitive processes of readers. This study explores whether there is any effect on detecting and restoring wrongly written characters in context for readers of Chinese as a second language. How phonetics and orthography are linked to each other are used to further explore and discuss the above controversy.

Therefore, based on the connectionist model this study uses an eye movement experiment to analyze the recognition speed of similar orthography, similar phonetics and orthography, and homophones in the correct context for Chinese learners from different language backgrounds (Sino-sphere and non-Sino-sphere) and different language levels. Through a comprehensive analysis of three variables, early eye movement indicators (first fixation duration and first run dwell time) are analyzed. Visual time and late eye movement indicators (total dwell time, regression path duration, and fixation count) are used to illustrate the recognition sequence and speed between orthography, phonology and semantics. In the process, a more specific connectionist model is established.

Five noteworthy results are clear: (1) There is no significant difference in eye movement between sentences with and without wrongly written characters, so it is believed that the words can be read smoothly by learners, that is, the wrongly written character can be automatically repaired to complete the understanding of words and sentences. (2) Sino-sphere and non-Sino-sphere learners both show a strong connection between orthographic and semantics in the early recognition process of language, but the effect of recovery and detection of non-Sino-sphere learners is weaker than Sino-sphere learners. (3) Sino-sphere learners recognize better characters that have similar orthography, which means that the connection between orthography and semantics is stronger; the non-Sino-sphere learners recognize better the homophone. In other words, the connection between phonetics and semantics is stronger. (4) In the later stage of the cognitive process of character recognition, Sino-sphere learners rely more on the conversion of phonetics and semantics. Non-Sino-sphere learners have the same decoding speed for the phonetic, orthographic, and combination. (5) In the model of native speakers' recognition, the decoding

speed of the combination of phonetic, orthographic, and combination are the same, and none of them is dominant. Therefore, its cognitive structure is a stable and mature structure in native readers.

Overall, learners of Chinese as a second language perform differently in detecting and restoring wrongly written character in reading, and learners of different language backgrounds and language proficiencies have different performance in Chinese character recognition. This has important implications for teaching Chinese characters and words to speakers of other languages. Teachers can learn from this study how to improve teaching methods, and Chinese learners can adopt more scientific and effective learning methods.

关键词：错别字识别、联结主义模型、眼动实验

Keywords: Mistyped character recognition, connectionist model, eye movement experiment

1. 研究缘起

在汉语作为第二语言教学中，阅读教学是师生双方不可避免的一大关卡。其中，汉字的认读更是留学生学习汉语的一大障碍。汉字作为一种表意文字，语音与字形信息如何影响学习者对汉字的识别依旧是研究的热点，并且，对于不同语言背景和语言水平的留学生而言，其对汉字学习的学习速度和学习效果也不尽相同。比如，有证据显示，英语母语者有时和汉语母语者一样，在阅读词序错误的语句时，可以顺畅地理解语句的语义。那么，这是否意味着汉语二语学习者在汉语学习中，能够像母语者对错序的认知一样对别字有着同样的检测和复原效应呢？

此外，汉语作为一种表意文字，虽与拼音文字之间有很大区别，但 Chen、Allport 和 Marshall（1986）研究表明，汉语中存在与英语中类似的词语优先效应——在英语中，嵌入词中的字母较易识别，在汉语中，嵌入汉字的偏旁较易被识别。Chen 等（1996）的研究中设定了三类汉字——汉字（正确使用的字）、假字（符合造字规律但并不适用的字）以及非字（不符合造字规律也并不使用的字），并将目标部首分别嵌入进三类汉字中。将汉字快速呈现给被试者，并紧接着进行后续刺激再认测试，询问被试者刚刚呈现的是哪一个部首。实验结果表明，三类汉字中的部首再认正确率呈现如下从高到低的排序：嵌入于汉字中的部首、嵌入于假字中的部首、嵌入于非字中的部首。

上述研究有一些不足之处。首先，对汉语字词阅读的眼动研究并未探讨汉字正字与音韵之间的具体认知关系及过程。其次，汉语母语者在汉字中较易识别偏旁，但并未探讨实质上的词语环境下，若其中的语素或单字被替换，是否会同样发生词语优先效应。最后，汉语作为第二语言的阅读眼动研究相对于第一语言的研究还比较缺乏。

本文将以汉语作为第二语言的留学生为研究对象，采用眼动研究方法观察其在正确上下文语境中是否会对别字产生相应的检测和复原，以及若发生此效应，其中语音和字形在别字识别中分别起到了多大的作用。研究将以联结主义理论为基础，建立起相应的联结主义模型来解释所观察的现象，并以此对于汉字的教和学提出有关建议。

具体而言，本文将会通过眼动实验的方式，对以下三个假设进行验证：

- **假设 1**：在词义上层阶段，即使下层的语音或字形改变，也会受到自上而下的语境的影响，自动修复别字，不影响阅读进程。这种效应可以发生在语言的早期阶段，并随着语言水平提高，阅读者将会从依靠字音转为依赖字形。
- **假设 2**：非汉字文化圈的学生在正确词语语境下面对同音异形别字或同音形似别字时，会比汉字文化圈学生表现出更强的汉字检测和复原效应。
- 汉字文化圈学生在面对异音形似别字时会比非汉字文化圈学生表现出更强的汉字检测和复原效应。
- **假设 3**：联结主义模型下正字层、音韵层与词义层之间的神经沟通可能并不同于普通的三层等距结构，而是呈现以词义为中心层的正字层与音韵层的松散关系。

2. 理论综述

2.1 阅读心理学理论综述

阅读是一种非常复杂的生理和心理活动。阅读心理学认为，人的大脑中存在着一种语言知识库，其中存储着学习者源于语言和文字的知识以及文化知识。同时，阅读心理学研究阅读者在阅读过程中所产生的一系列心理现象以及内部规律。

2.1.1 加工方式

阅读过程的模式指人们在阅读时从获得视觉信息到获得意义信息的全部心理过程，共分为三类：

第一类为自下而上的模式（bottom-up model）。该模式认为，阅读中的每一个阶段都是独立的，以词语为先导，采用由低级到高级逐步扩展的方式对语言进行解码活动。读者先从材料中获取文字信息，然后进行语义、语法处理。信息传递只有一个方向，高级阶段加工的信息不影响低级阶段的信息加工。

第二类为自上而下的模式（top-down model）。该模式认为，阅读是一个选择的过程、一个做出暂时决定和预期的过程，是知觉系统运用已有知识和经验为先导去搜索主要意义的过程。在阅读过程中，读者运用高层次的知识来理解低层次的结构，从而达到对语篇的理解。

第三类为阅读互动模式（the interactive model）。该模式认为，阅读是读者与所读语言材料之间相互沟通、相互作用的过程。它不是自上而下的阅读模式和自下而上的阅读模式简单相加，而是两者之间所包括的多种因素相互影响、共同运作的结果。其代表人物为 Perfetti（1985），他所坚持的互动原理强调了低水平加工（lower-lever process）在解码过程中的的强式影响，也表明了高水平加工（higher-level process）对无效的低水平加工的补偿。

本文采取第三类阅读互动模式，认为自上而下模式与自下而上模式交互进行。在此基础上，本文作出假设：在词义上层阶段，即使下层的语音或字形改变，也会受到自上而下的语境的影响，自动修复错字，不影响阅读进程，即上层次的语义对下层次的无效别字的补偿。

2.1.2 词汇优先效应

Reicher（1969）首先对英语环境中，在控制反映因素下，会产生词语优先效应提供了证据。其研究发现在词的语境下，辨认字母的效率要更高些，意味着词的加工有助于字母的辨认。这便是词语优先效应，即词的语境会影响我们对字母的感知。Healy（1976）发现，当字母嵌入在 the 或其他高频词中时，读者更容易遗漏字母。

而与英语处于不同语言系统的汉语，同样也存在相似的效应。Chen 等（1996）将目标部首分别嵌入汉字、假字和非字中。最终发现，在汉字中呈现的部首要比呈现在假字中的部首的再认正确率高，而呈现在假字中的部首又要比呈现在非字中的部首再认正确率高。这表明，嵌入汉字中的偏旁较容易被识别。

以上两项研究表明在英语语言系统中，嵌入在词语中的字母更容易被识别，同时，在汉语语言系统中，嵌入在汉字中的部首更容易被识别。综上所述，当单词为读者所熟悉的时候，读者会把它们感知为完整的单位而不是一组字母。那么，除了汉字中偏旁的较易感知之外，汉语词语语义完整时，读者是否会更容易感知汉字。本研究将会对此进行探讨。

2.1.3 字的检测和复原效应

字的检测和复原效应为自定术语，定义为：阅读者在阅读正确语境下的语句时，若其中嵌入别字，可通过语音形式以及词形形式，对别字进行检测和复原，以达到正确理解语句语义的作用。

Balota、Pollatsek 和 Rayner（1985）以及 Binder、Pollatsek 和 Rayner（1999）的研究中认为单词的词形是处于词汇通达识别的早期。并且 Pollatsek、Lesch、Morris 和 Rayner（1992）提出语音形式也可以在副中央凹视觉区被提取出来。Miellet 和 Sparrow（2004）发现语音形式和词形对于副中央凹区域的词语识别都具有重要的作用。其测试语言为法语，通过嵌于句子中的 60 个目标单词，并且每个单词有 3 种呈

现形式，分别为正确，错字（假字）形式以及同音异形异义错字，其中一半的控制组和一半的同音异形异义单词是在词形上类似的。并且被试者在阅读过程中并未发现错字，也就是被试者通过音和形的作用自动检测和修复了错字。

汉语研究中对别字的阅读研究较少，主要集中于单独的形声字中的形、音、义识别过程研究。这些下文中将会涉及，因此在下文中详细分析，由于以上现象表明语音和词形加工这低一级水平会影响到对词义的感知。在英语体系中，这符合联结主义的正字法——音韵层——词义层的先后层级。但正字法这一低层与语音加工的关系并没有作进一步讨论。

基于以上研究，本文作出相应假设：阅读中，在词汇语境中感知汉字之后，若词语中有别字时，读者可能会发生汉字的检测和复原效应。

2.1.4 两种理论模型

1. 双通道模型（dual-route model）：读者可以通过“词典通路”以及“非词典通路”这两条道路来表现声音及书写符号的关系。首先，“词典通路”指者通过视觉信息提取词语中的词形特征，从而激活语音特征懂得词义或者通过词形特征激活词义特征再激活语音特征。这一条通路需要借助心理词典，因此被称之为“词典通路”。其次，“非词典通路”则是不需要借助心理词典，视觉信息在进行初级加工以后，通过亚词汇水平的形音对照规则直接通达语音特征了解词义特征。这两种通道平行、独立存在于词义加工中，哪一种通路的加工速度更快，便使用哪一种通路提取词义。

2. 联结主义模型（Connectionist Model）：包括三个层次——正字层、音韵层、词义层。字与音之间的联系是由读者的经验所决定的。联结主义认为词汇是以分布的方式存储在心理词典中，一个词条可以由多个神经元来表征，一个神经元可以同时参与不同词汇的表征，多个神经元的不同激活模式表征着不同的词条。阅读是一个并行加工的过程，在空间上表现出各个单元同时激活，同时参与信息加工过程，在时间上表现为不同网络层同时加工。（杨剑锋&舒华, 2008）对于联结主义而言，其主要具有代表性的模型有以下四种，分别为：前馈网络模型（Feed Forward Network Model）、简单循环网络模型（Simple Recurrent Unit Network Model）、完全循环网络模型（Total Recurrent Network Model）、互动激活网络模型（Interactive Activation Network Model）。第一类前馈网络模型（图 1）为联结主义模型中目前运用地最为广泛的一类，由 Newell 和 Simon（1976）提出。单元被分为三个层次，按照同一个方向进行流动，从输入单元（input units）开始，经过内部层次隐藏单元（hidden units），最后通过输出单元（output units）进行输出。单元与单元之间的联结是通过权值（weight）来完成的，权值越大，单元之前的联结程度越紧密，而当单元之间的权值稳定在一个程度后，学习便完成了。前馈网络模型带给学者最大的思考便是：单元与单元之间的联结是可以通过隐藏单元去与其他单元进行调节的，更有效反应出输入与输出之间的内在关系。

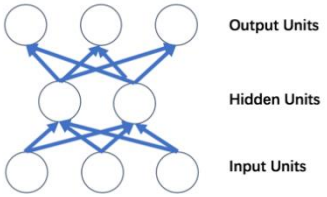

图 1 前馈网络模型

而第四种互动激活网络模型（图 2）类似于我们前文中提到的阅读互动模式。在互动激活网络模型中有三个层次的单元，分别为自上而下的单元（Top-down units），中间单元（Intermediate units）与自下而上的单元（Bottom-up units）。在认知和学习过程中，从最底层的自下而上单元开始，通过中间单元，到达自上而下的单元，与前馈网络模型不一样的是，该模型之间的联结是是双向的，单元与单元之间既可以自上而下，也可以自下而上，且联结既可以是起强化作用的，也可以起抑制作用的，通过不断的抑制或强化，达到单元与单元之间的稳定联结。

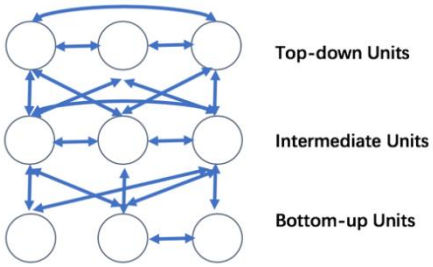

图 2 互动激活网络模型

互动激活网络模型可以用来解释上文中所提到的词语优先效应与字的检测和复原效应。对于嵌入在汉字中的部首而言，由于汉字中的其他笔画或部首被识别，激活了其他部首相关的汉字，激活后，自上而下进行反馈，增强了单个部首的辨认度和激活强度，因此，嵌入汉字中的部首比嵌入在假字和非字中的再认正确率高。并且对于字的检测和复原效应而言，互动激活网络模型也可以进行相应的解释。别字激活了相似的其他汉字的单元，正确汉字的感知自上而下地强化了对字形的感知联结，因此我们可以向感知正确汉字那样感知别字。

综上所述，双通道模型与联结主义模型之间存在以下几点差异：

一、双通道模型认为阅读者对词汇的识别来自与两种通道，两种通道并行加工，哪一种通道加工更快决定着词汇加工的结果。但对于联结主义模型而言，多个神经元共同进行加工，不区分“词典通路”与“非词典通路”。

二、双通道模型中的第二条通道“非词典通路”实质上为阅读者通过“形音义”的方式激活相关表征。而联结主义模型直接围绕着“形音义”进行建模，且互动激活网

络模型中，形音义之间可以自上而下与自下而上共同作用。由于双通道模型中的“词典通路”在本次实验中较难排除其影响，因此采用联结主义模型。

本文中采用联结主义理论，基于互动激活网络模型之上，正字层与音韵层的联结象征着形与音的对应，而阅读则是学会建立字形与语音之间的关系。并且一个词的形与音联结关系的建立能促进具有相同形与音的对应关系的其他词的加工和学习。

在正确的词语环境下，若词语中的语素或单字语音不改变，只改变字形（同音异形或同音形似），也不会产生语义上的歧义，那么语音与字形之间的联结关系会因此改变，字形与语义之间的联结被削弱，阅读者可能会依靠语音与语义之间的联结进行强化。同样，若在正确的词语环境下，词语中字形中大部分的部件或形旁保持不变，但改变其声旁，即语音被改变（异音形似），那么语音与字形之间的联结关系会变得不那么稳定，字形与语义的联结关系会进行强化，变得更紧密。

若以上推测成立，可以推论出形与音之间的关系在汉语系统中可能并不是十分稳固，但正确语境下的语义与形，或语义与音之间的联结关系相较前面一种情况更为稳固，对于汉语学习者而言更为重要。基于上述假设，便可以推测建立一个新的模型：联结主义模型下正字层、音韵层与词义层之间的神经沟通可能并不同于普通的三层等距结构，而是呈现以词义为中心层的正字层与音韵层的松散关系。

2.2 眼动理论综述

前人对汉语阅读做出了诸多研究，主要是对汉语字词、句子、语篇和不同文体等几个方面的阅读眼动研究，其中对于字词的研究集中于词频、笔画数、熟悉度、预测性，和语音在阅读加工中的作用，以及汉字的阅读知觉广度。

由于本文着重研究语音与字形之间的关系，因此现详细探讨此部分。

张益荣（2009）的研究中结合了词汇判断法与语义相关法，并采用了行为实验法以及眼动实验方法，对汉语母语者对词语中的单字激活与双字激活情况进行考察，分析语音与字形对词汇识别的影响，并进一步分析两者在识别不同阶段的作用。其关于语音、字形方面得出两个相关结论：（1）字形、语音的作用：在单字激活的情况下，字形激活的效应最大，准确语音激活和非准确语音激活同样产生了显著效应。但在双字激活的情况下，却没有显著的字形激活，存在准确语音和非准确语音激活的效应。（2）词汇不同加工阶段的不同：准确以及非准确语音激活都只出现在词汇识别过程中的晚期阶段。

但该研究在检测单字激活效应时，采取行为实验法，因变量只选取了正确率和反应时间，其仅运用反应时间很难反映出语音、字形在识别阶段的科学性，因此在本次实验中，仅运用眼动实验的方式，探求句子中语音、字形的单字激活效应。

迟慧等（2014）的研究中探讨了声旁语音信息在汉语形声字中的影响及作用，

其通过两项眼动实验考察了左右结构和上下结构中的形声字中语音对形声字加工的影响，结果发现，声旁信息无论在单字命名任务下还是自然阅读句子中，都对形声字的识别和加工起到一定的作用。并且该研究证明了双通道模型的正确性，支持形义和形、音、义两条通路并存并相互竞争。

Feng、Miller、Shu 和 Zhang（2001）考察了中英文读者在阅读中如何利用与语音和正字法特征。最后的结果表明，中文中没有早期的语音激活，但对于两种语言，同音异义错误在后期加工的测量中都有优势，说明语音有助于读者从错误的破坏效应中恢复。

Ma 与 Chuang（2015）使用眼动实验的方法探究汉字中复杂度与易读性之间的关系。被试者为 13 名平均年龄为 21 岁的汉语母语者，电脑展示完目标单字后，他们需要在 3 个汉字（1 个正确汉字以及 2 个相似汉字）选择认为符合的一项。结果发现，汉字的区块结构影响着被试者的可读性并且不同的汉字结构也影响着回视、注视次数以及复杂度。通过该研究，可以表明汉字的字形确实在汉字阅读起到一定的作用，但在何种阶段起到作用该研究并没有进行深入研究。

刘萍萍、李卫君、韩布新和李兴珊（2014）研究了书写错误对汉语阅读中的眼动影响。被试者需要阅读含有关键双字词的语句，并且关键词语呈现三种情况，一为正常无错误的词；二为缺少笔画的词语（双字词的首字第一个笔画数被移除）；三为异常字（双字词的首字被替换）。其实验结果表明，异常字显著影响了词汇与句子的加工时间，但笔画却并没有产生显著效应。该研究对异常字并没有进行定性的进一步分析，本研究旨在拓宽异常字的分类，并探究语音或字形相似的异常字是否会影响加工时间。

此外，以上有关语音与字形的研究都仅仅在汉语作为第一语言的阅读中，对汉语作为第二语言的研究则显得十分缺乏。本次研究以留学生作为研究对象，检测是否语音对汉语阅读有重要作用，并以初级水平和高级水平留学生作为对比组，检验语音以及字形作用发生的识别过程中所处的阶段。

2.3 有关“别字”的研究

2.3.1 留学生别字书写研究

在汉语中，汉字的错误书写分为错字与别字两类。其中，错字指形体不正确、不符合汉语书写规范的字。而别字是指形体正确但使用错误的字。对于汉语作为第二语言的学习者而言，错字和别字都是一种中介语的状态。

本文主要研究别字，这主要是因为别字更能体现学习者的正字法水平。错字的结构本身的组合关系就不符合汉字的笔画规则，其反映了学习者对汉字的结构规则的理解还处于比较低的水品。但别字的音、形、以及部件之间的组合都符合汉字的规则，只是学习者正在使用过程中把甲字错当成乙字。这表明学习者心中已经有了

甲字的知识或字形，但缺乏形音义相对应的知识，所以别字的出现反映出学习者对汉字结构的更进一步认识。

吴英成（1990）对新加坡一所高中学生 30 人听写 130 字短文时出现的汉字错误进行分析，其研究表示错字比例远低于别字比例（在 364 个错误中，错字占 11.8%，而别字占 88%）。他认为这是由于现代汉语中存在着大量的同音字或音近字，并且字音相同所造成的学习难度大于字形相近造成的难度。

而江新和柳燕梅（2004）对拼音文字背景的留学生进行汉字书写错误研究时发现，被试者书写错误中错字比别字多，与吴英成（1990）的研究结果不一致。若只关注留学生书写的别字错误，其研究表明别字错误主要是由字形混淆引起的，而由字音相同或相似的别字错误相对比较少，这也表明拼音文字背景的初级留学生在汉字书写中字形的作用远大于字音的作用。并且研究表明随着识字量的增大，字形作用减弱，字音作用增强。

上述两项研究的结果不一致可能是由于被试者汉语水平不一致所造成的，前者为新加坡中学生，后者为初级阶段的留学生，前者的水平较高，可能在某个阶段之后，后者的错误率就可能是别字的错误数量大于错字的。但两项研究都表明，随着汉语水平的提高，汉字书写中字形作用在减弱而字音作用在增强。

2.3.2 汉语母语者别字书写研究

前人对于汉语母语者的别字研究较少，主要集中于以汉语作为第二语言的留学生别字产出上。朱明恒（2016）对比了留学生与中国小学生汉字书写习得分析比较，其中以初学汉语的留学生和中国一年级小学生为研究对象。其研究表明，绝大部分小学生书写汉字时不会出现错别字。在收集到的错别字中，别字数量和错字数量都很小，别字中也出现了因字音和字形的混淆而引起的别字错误。但学者并未深究其中的比例关系，而是着重于研究笔画错误，分析产生错字的最大原因是汉语中的笔画笔形较为相似，小学生容易混淆。

以上研究并未体现音韵及字形在母语者书写时的作用比重，由于母语者在母语环境中接触的汉字很多，其识字基础较为夯实。因此，汉语母语者产出别字错误的过程中较难监测，也很难与留学生输出的过程相比较。

2.3.3 汉语母语者别字阅读研究

对于别字的字形—字音关系多为书写研究，有关阅读的研究则比较少。在阅读中，别字的出现是否可以反向作用于形音义之间的关系，促使留学生看到错误的形音关系时，可以通过上下文语境推理出正确的汉字——即汉字复原和检测效应。本文将对此作进一步探讨。

前人并未专门研究阅读中的别字认知过程，而是观察中文阅读中字音、字形的

作用及其发展转换。宋华、张厚粲和舒华（1995）在实验中考察了小学三、五年级以及大学生在进行接近正常阅读的校对任务时，字音、字形在其中起到的作用。实验得出两个结论：（1）字词识别能力随着年纪、语文能力的提高而增强；（2）在中文的字词识别过程中的确存在着语码的发展转换。初学阅读者在阅读中主要依靠的是字音，而成人熟练阅读者在主要依靠的是字形。在同一年级内，能力高的儿童首先向下一阶段转换。

2.3.4 留学生别字阅读研究

高立群和孟凌（2000）做了 3 次实验，分别对比了汉语初学者、中级、高级水平留学生以及母语者对存在于阅读材料中音同别字、形似别字进行校对。阅读有且只有一次，并需要按顺序阅读，被试者要尽力做到最快。结果发现，第二语言学习者对汉字的识别随着语言水平的提高而提高。在汉语阅读中，第二语言学习者对汉字的字形意识强于字音意识。并且，第二语言学习者的汉字字形的意识强于字音的特点并没有随着汉语水平的提高而变化，这与上文中宋华等(1995)研究的汉语母语者的情况有所不同。

吕欣航（2007）所做的研究与高、孟的研究类似，其对 102 名初级、中级留学生进行实验， 被试者只有一次机会阅读并校对存在于阅读材料中音同别字、形似别字。吕在高、孟的基础上，将留学生分为了汉字圈以及非汉字圈。研究表明，第二语言学习者在汉语阅读时主要运用字形的信息，字音的信息则运用较少，并且水平初级或中级，不同文字背景的留学生都主要依靠字形激活字义，因而对音同别字很容易察觉，而对形似别字很难察觉。

张金桥（2007）同样运用校对实验探讨了拼音文字背景下的留学生与表意文字背景下的留学生在汉语阅读中的字音与字形的作用。从而探究其母语的认知加工特点对其汉语阅读中的作用。结果表明，初级阶段的拼音文字背景留学生在汉语阅读时字音起着主要作用，中级水平的拼音文字背景留学生在汉语阅读时字音与字形起着同等重要的作用。但对于初级和中级的表意文字背景留学生在汉语阅读时都是字形起着主要的作用。

以上三项研究都是学者运用校对任务测试留学生或不同文字背景的留学生对音同别字和形似别字的认知，但对不同文字背景的学生依靠字形还是字音没有一致的研究结果。并且对比别字的书写研究和阅读研究，发现书写者和阅读者在发展阶段中的转换不一致。书写者从依赖字形转换到依赖字音，而阅读者从依赖字音转换到依赖字形。这其中的不同可能是由于语言背景和语言水平不一致而引起的。因此，本文依托于前人的理论基础，运用眼动实验为手段，研究不同文字背景下不同语言水平的留学生和母语者对同音异形别字、同音形似别字以及异音形似别字的识别过程及认知方式，观察在阅读过程中哪一种转换更为准确，从而对对外汉语汉字教学提供一定的教学建议。

2.4 语言迁移的潜在影响

迁移（transfer）指在学习过程中已获得的知识、技能和方法、态度等对学习新知识、技能的影响。其中分为正迁移（positive transfer）和负迁移（negative transfer），后者也被称为干扰。正迁移指在一种情境中学的东西有助于在另一种情境中进行学习。负迁移指在一种情境中学的东西干扰在另一情境中进行的学习。

在汉语学习中，非汉字文化圈和汉字文化圈的留学生对汉字的敏感度不同，前文已经提及研究表明语音编码在英语阅读中起着重要的作用。那么，本文预测非汉字文化圈的学生在面对同音异形别字或同音形似别字时，会比汉字文化圈学生表现出更强的别字复原和检测效应。并且汉字文化圈学生在面对异音形似别字时会比非汉字文化圈学生表现出更强的汉字复原和检测效应。

3. 研究方法

3.1 实验设计

实验为 3×3×4 三因素混合设计，自变量分别为不同语言背景（非汉字文化圈学习者、非汉字文化圈学习者以及母语者），不同语言水平（初级水平、高级水平以及母语水平）和句子类型（正确句子、包含同音异形别字句子、包含同音形似别字句子、包含异音形似别字句子）。对于基于字、词语的兴趣区上，因变量为被试者的眼动指标：首次注视时间、凝视时间、注视次数、总注视时间、回视路径时间。对于基于整句的兴趣区上，因变量为被试者的眼动指标：平均注视时间、总阅读时间、总注视次数。

本次实验分析中，实验眼动指标将按照基于字、词语兴趣区上的眼动指标与基于整句的兴趣区的眼动指标定义为局部指标和整体指标。并且，局部指标分为早期指标、晚期指标。其中，早期指标为首次注视时间、凝视时间；晚期指标为注视次数、总注视时间、回视路径时间。

3.1.1 眼动指标

（1）字或词语兴趣区的眼动指标：

早期指标：

首次注视时间（first fixation duration）指的是读者第一次注视该字的时间。一些研究表明，读者对歧义句中的歧义单词的首次注视时间比没有歧义的句子中同样位置的单词的首次注视时间长。首次注视时间作为初始加工的指标，用于读者第一次看到关键字并只有一次注视的情况下。而关键词比较复杂或读者不熟悉时，读者第一次看到该字，可能会有多个注视点，那么应该使用凝视时间作为指标。

凝视时间（first run dwell time）指的是在读者注视点落在另外一个字上以前，对当前所注视字的总的注视时间。有部分研究者认为凝视时间是对一个字的加工时间的最好的指标。

晚期指标：

注视次数（fixation count）指的是兴趣区被注视的总次数。注视次数能有效反映阅读材料的认知加工负荷。

总注视时间（total dwell time）指的是读者对某个字所有注视时间的总和，其反映了加工该字的时间。由于总注视时间考虑了再读时间，因此这是一个晚期注视时间的指标。

回视路径时间（regression-path duration）指的是从某一区域的首次注视时间到最早一次从这一区域向右的运动之前的所有注视时间之和。回视路径时间是反应晚期加工的良好指标，是作为句子精细加工中的重要指标。

（2）整句兴趣区的眼动指标

平均注视时间（mean fixation duration）指的是落在句子上的所有注视点的持续时间的平均值。

总阅读时间（total reading time）指的是对整个句子的所有阅读时间之和。其反映了对信息的总加工时间。

总注视次数（fixation count）指的是落在句子上的注视点总个数。

3.2 被试者

本次眼动实验中，被试者包括 60 名来自中国各高校的汉语学习者，其中非汉字文化圈学生 30 名（初级水平、高级水平各 15 名），汉字文化圈学生 30 名（初级水平、高级水平各 15 名）。非汉字文化圈学生分别来自泰国（7 名）、美国（5 名）、德国（3 名）、英国、斯洛文尼亚、瑞士（以上各 2 名）、澳大利亚、法国、挪威、荷兰、西班牙、土耳其、印度、印尼、肯尼亚（以上各 1 名），且这些学生都为非华人或来自华人背景家庭。汉字文化圈学生分别来自韩国（19 名）、日本（11 名）。再加上汉语母语者 15 名，本次实验总被试者人数为 75 名。

为保证被试者的水平分级具有科学性，并且识字量水平保持一致性，本次实验结束后进行的初级水平被试者通过测试后的识字量检测（请见附录 2），平均得分为 41.035 分（其中汉字圈初级水平被试者的平均得分为 43.07 分，非汉字圈初级水平被试者的平均得分为 39 分）；高级水平被试者平均得分为 59.87 分（其中汉字圈高级水平被试者的平均得分为 65 分，非汉字圈高级水平被试者的平均非得分为 59.87

分）。经 SPSS 分析后，初高级水平差异显著，同一水平内不同汉字背景差异不显著，因此符合实验标准。

眼动实验中，所有被试者的视力或矫正视力为正常，实验结束后均得到一定的报酬。

3.3 实验材料

3.3.1 眼动阅读材料

实验材料为 40 个句子，并为每个句子设计阅读理解的题目，都为判断正误题。实验材料的确定经历了以下步骤：

1、从“Chinese reading world”中抽取 40 个句子，保持汉字与词语难度等级一致、句法难度等级一致、句长基本一致。其中字词的难度等级通过字词的出现频率进行比较，并参考《汉语水平词汇与汉字等级大纲》（国家汉语水平考试委员会办公室考试中心，2001）。

2、实验句子分为 4 类，请见附录 1。

本次实验中，别字被分为三大类，分别是同音异形别字、同音形似别字、异音形似别字。这里排除了异音异形别字，是因为正确字与别字之间既没有语音方面的联结，也没有字形方面的联结，无法作定性分析，因此去除该类。

（1） 无激活对照组：10 句正常通顺句子，词语完全正确。

（2） 字音激活对照组：10 句包含同音异形别字的句子，每句中有一个别字。

- 同音异形别字指别字在字音上与正确字相同，但字形完全不同的字。例如：其他——齐他、知道——知到。
- 实验材料：才五分钟，天气就从暖和的情天变成了大雨，大自然的变化可真是快啊！

（3） 字音、字形激活对照组 10 句包含同音形似别字的句子，每句中有一个别字。

- 同音异形别字指别字在字音上与正确字相同或相似，并且字形也相似的字。例如：天气——天汽、青色——清色。
- 实验材料：春天是个很美的记节，希望每个人都能好好利用春天，快乐地度过这可爱的记节。

（4） 字形激活对照组：10 句包含异音形似别字的句子，每句中有一个别字。

- 异音形似指别字在字形上与正确字相似，但字音并不相同或不相似的字。例如：今——令、口——口。
- 实验材料：我们班上来了一位新同学，我汪意她很久了，我想她一定知道我喜欢她。

3.3.2 识字量测试材料

本次实验后测试的识字量表，采用王骏（2019）通过分析非汉字文化圈学习者从零起点，在一年内学习某初级教材所要求掌握的全部汉字后的实际掌握情况，得出了全体汉字难度等级的公式，以及建立了“外国人汉字习得数据库”。本文依据其研究的附录 6《汉字水平词汇与汉字等级大纲》2884 字的难度值，进行随机筛选，依托于王骏（2019）年的识字考核方式，选取了 30 个汉字，30 组词，并根据施家炜（1998）年总结出的 22 种外国留学生习得的句式中随机选取 10 种进行语法测试。

3.4 实验设备

实验采用加拿大 SR research 公司生产的 eyelink-1000 Plus 眼动仪，采样率为 1000Hz，被试机屏幕的刷新率为 60Hz，分辨率为 1024*768 像素，被试眼睛距离屏幕 78cm，汉字为宋体 32*32 像素，行距为 70 像素。

3.5 实验步骤

1. 所有被试者在正式实验前应被告知只有一次阅读机会，并讲解实验的操作过程。
2. 被试者在负责人的指导下，进行模拟实验。
3. 实验开始——结束。
4. 实验结束后进行问卷调查（调查内容包括姓名、国籍、学习汉语时间）以及测试识字量、测试识词量。

通过筛选识字得分，本次实验共选取了 75 名被试者的实验资料。实验数据采用 SPSS23 作为分析工具，以被试者的各项数据作为随机变量，对处于别字兴趣区的各眼动指标进行分析。

4. 实验结果

为了保证实验数据的纯洁性，本文将删除平均值加减 3 个标准差之外的极端数据以及首次注视时间小于 60ms、大于 800ms 的数据，删除数据占总数据的 16.09%。按照 Yang、Wang、Tong 和 Rayner(2012)的研究，是对首次注视时间小于 80ms 的数据进行删除，但中文阅读中短注视点相对于英文更多，因此将标准定为 60ms。

4.1 别字上的眼动指标

在数据统计中，存在一些数据为 0 的数据，其是因为被试者发生了眼跳行为，而发生眼跳行为的原因有三：兴趣区处于句首，兴趣区处于句尾以及被试者认为兴趣区词语为不重要的信息，因此选择忽略此部分信息。

表 1 别字眼动指标均值表（ms）

因变量	语言背景	语言水平	别字类型	平均值	标准误差
首次注视时间	.222	.821	.029		
	汉字圈	初级	同音形似	264.361	15.822
			同音异形	259.576	15.211
			异音形似	248.176	14.986
		高级	同音形似	289.635	15.569
			同音异形	272.178	14.463
			异音形似	255.594	15.447
	非汉字圈	初级	同音形似	285.357	14.770
			同音异形	284.972	14.666
			异音形似	273.029	14.770
		高级	同音形似	281.846	15.327
			同音异形	292.366	14.666
			异音形似	235.671	14.770
	母语	母语者	同音形似	227.686	20.888
			同音异形	240.763	16.088
			异音形似	223.173	17.137
凝视时间	.000***	.031*	.001**		
	汉字圈	初级	同音形似	362.623	38.329
			同音异形	374.227	36.849
			异音形似	323.294	36.303
		高级	同音形似	316.444	37.716
			同音异形	355.055	35.038
			异音形似	289.891	37.420
	非汉字圈	初级	同音形似	606.543	35.781
			同音异形	468.535	35.528
			异音形似	430.514	35.781
		高级	同音形似	402.385	37.131
			同音异形	591.803	35.528
			异音形似	337.200	35.781
	母语	母语者	同音形似	259.171	50.601
			同音异形	280.983	38.974
			异音形似	256.154	41.514
注视次数	.000***	.039*	.002**		
	汉字圈	初级	同音形似	2.803	.262
			同音异形	2.924	.252
			异音形似	3.412	.248
		高级	同音形似	1.984	.258
			同音异形	2.192	.240
			异音形似	3.109	.256
	非汉字圈	初级	同音形似	3.743	.245
			同音异形	3.042	.243
			异音形似	3.229	.245

		高级	同音形似	3.492	.254
			同音异形	2.746	.243
			异音形似	3.843	.245
	母语	母语者	同音形似	1.571	.346
			同音异形	2.034	.267
			异音形似	2.058	.284
总注视时间	.000***	.041*	.036*		
	汉字圈	初级	同音形似	731.246	78.325
			同音异形	795.742	75.299
			异音形似	878.985	74.184
		高级	同音形似	533.206	77.071
			同音异形	567.918	71.598
			异音形似	838.094	76.467
	非汉字圈	初级	同音形似	1056.900	73.116
			同音异形	895.845	72.600
			异音形似	882.357	73.116
		高级	同音形似	914.877	75.876
			同音异形	843.676	72.600
			异音形似	1014.271	73.116
	母语	母语者	同音形似	357.000	103.402
			同音异形	486.458	79.641
			异音形似	521.962	84.832
回视路径时间	.000***	.036*	.050*		
	汉字圈	初级	同音形似	742.033	78.802
			同音异形	821.273	75.758
			异音形似	892.103	74.636
		高级	同音形似	533.206	77.541
			同音异形	577.740	72.034
			异音形似	838.094	76.933
	非汉字圈	初级	同音形似	1056.900	73.562
			同音异形	896.296	73.042
			异音形似	882.357	73.562
		高级	同音形似	914.877	76.339
			同音异形	867.141	73.042
			异音形似	1014.271	73.562
	母语	母语者	同音形似	357.000	104.032
			同音异形	489.814	80.126
			异音形似	521.962	85.349

注：* p< .05，** p< .01，*** p< .001

1、首次注视时间

经过 SPSS 数据分析后，语言背景差异主效应不显著，F=1.495，P=0.222。语言水平差异主效应不显著，F=0.051，P=0.821。别字的类型主效应不显著，F=2.834，P=0.059。语言背景与语言水平的交叉效应不显著，F=2.284，P=0.131。语言背景与

别字类型的交叉效应不显著，F=0.522，P=0.593。语言水平与别字类型的交叉效应不显著，F=0.954，P=0.386。而三者的交叉效应也不显著，F=0.448，P=0.639。

2、凝视时间

经过 SPSS 数据分析后，语言背景差异主效应显著，F=41.718，P=0.000。语言水平差异主效应显著，F=4.674，P=0.031。别字的类型主效应显著，F=5.399，P=0.005。语言背景与语言水平的交叉效应不显著，F=0.357，P=0.550。语言背景与别字类型的交叉效应不显著，F=1.950，P=0.143。语言水平与别字类型的交叉效应不显著，F=6.126，P=0.002。而三者的交叉效应显著，F=4.447，P=0.012。

由于三者交叉效应显著，因此对其进行简单效应分析。

对于初级水平学生而言，汉字圈学生在阅读同音形似与异音形似别字时的凝视时间显著小于非汉字圈学生，P<0.037，在阅读同音异形别字时，差异不显著，P>0.65。对于高级水平留学生而言，汉字圈学生在阅读同音形似与异音形似别字时的凝视时间与非汉字圈学生差异不显著，P>0.100，在阅读同音异形别字时，汉字圈学生的凝视时间显著小于非汉字圈学生，P=0.000。

对于汉字圈学生而言，初级水平以及高级水平留学生在阅读三类别字时的凝视时间均无显著差异，P>0.390。对于非汉字圈学生而言，初级水平学生在阅读同音形似别字时的凝视时间显著大于高级水平学生，P=0.000，但在阅读同音异形别字时的凝视时间则显著小于高级水平学生，P=0.014，在阅读异音形似别字时，两者无显著差异，P=0.65。

初级水平汉字圈学生与高级水平汉字圈学生在阅读三类别字时，内部均无显著差异，P>0.495。初级水平非汉字圈学生阅读同音形似别字的凝视时间显著大于同音异形别字与异音形似别字，P<0.200。高级水平非汉字圈学生阅读同音异形别字的凝视时间显著大于其他两类别字，P<0.001。母语者在阅读三类别字时，内部也均无显著差异，P>0.961。

4.1.1 晚期指标

1、注视次数

经过 SPSS 数据分析后，语言背景差异主效应显著，F=18.077，P=0.000。语言水平差异主效应显著，F=4.279，P=0.039。别字的类型主效应显著，F=4.669，P=0.010。语言背景与语言水平的交叉效应显著，F=4.956，P=0.026。语言背景与别字类型的交叉效应显著，F=4.436，P=0.012。语言水平与别字类型的交叉效应不显著，F=2.493，P=0.083。而三者的交叉效应不显著，F=0.251，P=0.778。

由于语言背景与语言水平的交叉效应显著，因此对二者进行简单效应分析。对

于初级水平学生而言，汉字圈与非汉字圈学习者的注视次数差异不显著，P=0.152；对于高级水平学生而言，汉字圈的注视次数显著小于非汉字圈学习者，P=0.000。对于汉字圈学生而言，初级水平学生的注视次数显著大于高级水平学生，P=0.003；对于非汉字圈学生而言，初级水平学与高级水平学生差异不显著，P>0.910。

由于语言背景与别字类型的交叉效应显著，因此对二者进行简单效应分析。在阅读同音形似别字时，非汉字圈学生的注视次数显著大于汉字圈学生与母语者的注视次数，P=0.000，汉字圈学生与母语者差异不显著，P=0.105。在阅读同音异形别字时，汉字圈学生与非汉字圈学生、母语者的注视次数差异不显著，P>0.270，非汉字圈学生显著大于母语者，P=0.020。当阅读异音形似别字时，母语者的注视次数显著小于汉字圈与非汉字圈学生，P<0.002，汉字圈与非汉字圈之间差异不显著，P=0.608。

对于汉字圈学生而言，阅读异音形似别字时的注视次数显著大于同音形似别字和同音异形别字，P<0.16。对于非汉字圈学生而言，阅读同音异形别字的注视次数显著小于同音形似与异音形似别字，P<0.027。对于母语者而言，三类的别字注视次数并无显著差异，P>0.622。

2、总注视时间

经过 SPSS 数据分析后，语言背景差异主效应显著，F=23.956，P=0.000。语言水平差异主效应显著，F=4.205，P=0.041。别字的类型主效应不显著，F=2.874，P=0.057。语言背景与语言水平的交叉效应不显著，F=2.458，P=0.117。语言背景与别字类型的交叉效应显著，F=3.137，P=0.044。语言水平与别字类型的交叉效应不显著，F=2.451，P=0.087。而三者的交叉效应不显著，F=0.206，P=0.814。

由于语言水平差异显著，因此对其进行多重比较分析。初级水平学习者的总注视时间显著大于高级水平学习者与母语者，P<0.034。高级水平的总注视时间又显著大于母语者，P=0.000。

由于语言背景背景与别字类型的交叉效应显著，因此对两者进行简单效应检验。在阅读同音形似别字时，非汉字圈学习者的总注视时间显著大于汉字圈学习者和母语者的总注视时间，P=0.000 ；汉字圈与母语者无显著差异，P=0.056。在阅读同音异形别字时，非汉字圈的总注视时间显著大于汉字圈学习者和母语者的总注视时间，P<0.030；汉字圈与母语者无显著差异，P=0.116。在阅读异音形似别字时，母语者的总注视时间显著小于汉字圈与非汉字圈学习者，P<0.003，汉字圈与非汉字圈无显著差异，P=0.538。

汉字圈学习者阅读异音形似别字时的总注视时间显著大于同音形似别字，P=0.010，而对同音异形别字的总注视次数与对其他两类别字没有显著差异，P=0.052。非汉字圈学习者与母语者在阅读三类别字时的总注视时间内部都没有显著差异，P>0.30。

3、回视路径时间

经过 SPSS 数据分析后，语言背景差异主效应显著，F=22.361，P=0.000。语言水平差异主效应显著，F=4.419，P=0.036。别字的类型主效应不显著，F=2.874，P=0.057。语言背景与语言水平的交叉效应不显著，F=2.643，P=0.072。语言背景与别字类型的交叉效应显著，F=3.125，P=0.044。语言水平与别字类型的交叉效应不显著，F=2.312，P=0.100。而三者的交叉效应不显著，F=0.268，P=0.765。

由于语言水平主效应显著，因此对其进行多重比较。初级水平学习者的回视路径时间显著大于高级水平学习者及母语者，P<0.030。高级水平的回视路径时间又显著大于母语者，P=0.000。

由于语言背景与别字类型的交叉效应显著，因此对两者进行简单分析。汉字圈学习者阅读异音形似别字的回视路径时间显著大于同音形似别字，P=0.010。同音异形别字的回视路径时间与其他两类别字没有显著差异，P>0.079。非汉字圈学习者与母语者对三类别字的回视路径时间之间差异不显著，P>0.526。

在阅读同音形似别字时，非汉字圈学习者的回视路径时间显著大于汉字圈学习者与母语者，P=0.000；汉字圈与母语者无显著差异，P=0.051。在阅读同音异形别字时，非汉字圈的回视路径时间显著大于汉字圈学习者和母语者的回视路径时间，P<0.039；汉字圈与母语者无显著差异，P=0.083。在阅读异音形似别字时，母语者的回视路径时间显著小于汉字圈与非汉字圈学习者，P<=0.002，汉字圈与非汉字圈无显著差异，P=0.604。

4.2 别字所在词语上的眼动指标

表 2 别字所在词语上的眼动指标均值表（ms）

因变量	语言背景	语言水平	别字类型	平均值	标准误差
首次注视时间	.386	.815	.000***		
	汉字圈	初级	同音形似	257.169	13.606
			同音异形	278.789	13.018
			异音形似	240.685	12.839
		高级	同音形似	284.243	12.752
			同音异形	273.571	13.111
			异音形似	248.986	12.928
	非汉字圈	初级	同音形似	277.942	13.206
			同音异形	295.544	13.302
			异音形似	247.639	12.928
		高级	同音形似	279.957	13.111
			同音异形	293.563	13.018
			异音形似	228.042	13.018
	母语	母语者	同音形似	235.719	14.529

			同音异形	233.731	13.401
			异音形似	208.549	13.018
凝视时间	.000***	.001***	.010**		
	汉字圈	初级	同音形似	661.354	66.644
			同音异形	652.549	63.766
			异音形似	826.945	62.887
		高级	同音形似	502.892	62.460
			同音异形	544.286	64.220
			异音形似	643.264	63.322
	非汉字圈	初级	同音形似	907.551	64.684
			同音异形	962.662	65.158
			异音形似	1110.472	63.322
		高级	同音形似	782.571	64.220
			同音异形	877.859	63.766
			异音形似	1032.662	63.766
	母语	母语者	同音形似	335.474	71.168
			同音异形	351.537	65.642
			异音形似	304.451	63.766
注视次数	.000***	.153	.000***		
	汉字圈	初级	同音形似	3.908	.351
			同音异形	3.845	.336
			异音形似	6.192	.331
		高级	同音形似	2.919	.329
			同音异形	3.057	.338
			异音形似	5.153	.333
	非汉字圈	初级	同音形似	4.899	.340
			同音异形	4.721	.343
			异音形似	6.222	.333
		高级	同音形似	5.014	.338
			同音异形	4.535	.336
			异音形似	7.437	.336
	母语	母语者	同音形似	2.386	.375
			同音异形	2.716	.346
			异音形似	2.887	.336
总注视时间	.000***	.007**	.000***		
	汉字圈	初级	同音形似	1070.615	101.917
			同音异形	1071.606	97.516
			异音形似	1602.685	96.170
		高级	同音形似	737.514	95.518
			同音异形	787.286	98.210
			异音形似	1267.778	96.836
	非汉字圈	初级	同音形似	1408.232	98.919
			同音异形	1414.103	99.643
			异音形似	1758.097	96.836
		高级	同音形似	1355.671	98.210

			同音异形	1284.704	97.516
			异音形似	1973.155	97.516
	母语	母语者	同音形似	564.825	108.834
			同音异形	680.418	100.384
			异音形似	676.296	97.516
回视路径时间	.000***	.007**	.000***		
	汉字圈	初级	同音形似	1079.785	102.589
			同音异形	1066.746	98.159
			异音形似	1575.795	96.805
		高级	同音形似	748.851	96.148
			同音异形	785.900	98.857
			异音形似	1273.944	97.475
	非汉字圈	初级	同音形似	1412.174	99.571
			同音异形	1464.456	100.300
			异音形似	1788.375	97.475
		高级	同音形似	1383.543	98.857
			同音异形	1290.606	98.159
			异音形似	1988.775	98.159
	母语	母语者	同音形似	569.561	109.552
			同音异形	653.209	101.046
			异音形似	682.831	98.159

注：* p< .05，** p< .01，*** p< .001

4.2.1 早期指标

1、首次注视时间

经过 SPSS 数据分析后，语言背景差异主效应不显著，F=0.751，P=0.386。语言水平差异主效应不显著，F=0.055，P=0.815。别字类型差异主效应显著，F=11.632，P=0.000。语言背景与语言水平的交叉效应不显著，F=1.206，P=0.272。语言背景与别字类型的交叉效应不显著，F=0.963，P=0.382。语言水平与别字类型的交叉效应不显著，F=0.719，P=0.488。而三者的交叉效应同样不显著，F=0.423，P=0.649。

由于别字类型差异主效应显著，因此对其进行多重比较分析。被试者在阅读异音形似别字所在词语兴趣区时，首次注视时间显著小于同音形似别字与同音异形别字所在词语兴趣区的首次注视时间，F<8.333，P-0.000。同音形似别字所在词语与同音异形别字词语的首次注视时间没有显著差异，F=8.402，P=0.418。

2、凝视时间

经过 SPSS 数据分析后，语言背景差异的主效应显著，F=69.009，P=0.000。语言水平差异的主效应显著，F=11.071，P=0.001。别字类型差异的主效应显著，F=4.623，P=0.010。语言背景与语言水平的交叉效应不显著，F=0.539，P=0.463。语言背景与别字类型的交叉效应不显著，F=0.368，P=0.692。语言水平与别字类型的交叉效应不

显著，F=0.134，P=0.874。三者的交叉效应不显著，F=0.125，P=0.883.

由于三类差异分别各自的主效应显著，因此对三者进行多重比较分析。母语者对三类别字的凝视时间显著小于汉字圈与非汉字圈汉语学习者，并且汉字圈学习者对三类别字的凝视时间显著小于非汉字圈学习者，P=0.000。母语者对三类别字的凝视时间显著小于初级水平与高级水平汉语学习者，并且高级水平学习者对三类别字的凝视时间显著小于初级水平学习者，P=0.001。而学习者在阅读异音形似别字时的凝视时间显著大于同音形似别字与同音异形别字，P=0.000。阅读同音形似别字与同音异形别字时的凝视时间差异不显著，P=0.430。

4.2.2 晚期指标

1、注视次数

经过 SPSS 数据分析后，语言背景差异主效应显著，F=44.110，P=0.000。语言水平差异主效应不显著，F=2.048，P=0.153。别字类型差异主效应显著，F=15.605，P=0.000。语言背景与语言水平的交叉效应显著，F=11.507，P=0.001。语言背景与别字类型的交叉效应不显著，F=0.413，P=0.662。语言水平与别字类型的交叉效应不显著，F=0.901，P=0.406。并且三者的交叉效应同样不显著，F=1.593，P=0.204。

由于别字类型主效应显著，因此对其进行多重比较，异音形似别字的注视次数显著大于同音形似别字与同音异形别字，P=0.000，且同音形似别字与同音异形别字之间的注视次数没有显著差异，P=0.094。

由于语言背景与语言水平的交叉效应显著，因此对其进行简单分析。对于汉字圈学习者而言，初级水平学习者的注视次数显著大于高级水平学习者，P=0.001。对于非汉字圈学习者而言，初级水平与高级水平学习者的注视次数之间没有显著差异，P=0.167。对于初级水平学习者而言，汉字圈学习者的注视次数显著小于非汉字圈学习者，P=0.023。对于高级水平学习者而言，汉字圈学习者的注视次数同样小于非汉字圈学习者，P=0.000。

2、总注视时间

经过 SPSS 数据分析后，语言背景差异主效应显著，F=61.340，P=0.000。语言水平差异主效应显著，F7.345，P=0.007。别字类型差异主效应显著，F=22.996，P=0.000。语言背景与语言水平的交叉效应显著，F=8.441，P=0.004。语言背景与别字类型的交叉效应不显著，F=0.098，P=0.906。语言水平与别字类型的交叉效应不显著，F=0.694，P=0.500。三者的交叉效应不显著，F=1.073，P=0.342。

由于语言背景与语言水平的交叉效应显著，因此对两者进行简单分析。对于汉字圈学习者而言，初级水平学生对三类别字的总注视时间显著大于高级水平学生，P=0.000。对于非汉字圈学生而言，初级水平学生与高级水平学生的总注视时间没有

显著差异。P=0.890。对于初级水平学生而言，汉字圈学生对三类别字的总注视时间显著小于非汉字圈学生，P=0.001。对于高级水平学生而言，汉字圈学生对三类别字的总注视时间显著小于非汉字圈学生，P=0.000。

由于别字类型主效应显著，因此对其进行多重比较分析。汉语阅读者在阅读异音形似别字时的总注视时间显著大于其他两类别字，P=0.000。而同音形似别字与同音异形别字的总注视时间之间无显著差异，P=0.984。汉字圈学习者的总注视时间与非汉字圈学习者与母语者之间没有显著差异，P>=0.055。

3、回视路径时间

经过 SPSS 数据分析后，语言背景差异主效应显著，F=67.108，P=0.000。语言水平差异主效应显著，F=7.193，P=0.007。别字类型差异主效应显著，F=22.735，P=0.000。语言背景与语言水平的交叉效应显著，F=7.128，P=0.008。语言背景与别字类型的交叉效应不显著，F=0.027，P=0.973。语言水平与别字类型的交叉效应不显著，F=0.869，P=0.420。三者的交叉效应不显著，F=1.013，P=0.363。

由于别字类型差异主效应显著，因此对其进行多重比较。被试者在阅读异音形似时的回视路径时间显著大于同音形似别字和同音异形别字，P=0.000，且同音形似别字与同音异形别字之间没有显著差异，P=0.995。

由于语言背景与语言水平的交叉效应显著，因此对两者进行简单分析。对于初级水平学生而言，来自汉字圈语言背景的学生的回视路径时间显著小于非汉字圈背景学生，P=0.000。对于高级水平学生而言，来自汉字圈语言背景的学生的回视路径时间也显著小于非汉字圈背景学生，P=0.000。对于汉字圈学习者而言，高级水平学习者的回视路径时间显著小于初级水平学习者，P=0.000。对于非汉字圈水平学生而言，初级水平学习者与高级水平学习者的回视路径时间 没有显著差异，P=0.993。

4.3 整句上的眼动指标

整句上的指标分为正确无别字词语的句子与有别字的句子，将两类指标进行比较，以下表为指标的平均值，并且两者之间没有显著差异。平均注视时间的差异不显著，F=0.177，P=0.674。总阅读时间的差异不显著，F=1.212，P=0.271。总注视次数的差异不显著，F=1.942，P=0.164。因此，我们可以认为被试者对于正确和有别字句子均可顺畅阅读。

表 3 整句上的眼动指标均值表（ms）

	平均注视时间	总阅读时间	总注视次数
正确无别字的句子	236.19	14089.44	47.65
有别字句子	236.99	14575.30	49.59
显著性	.674	.271	.164

在得到以上结论之后，我们便进一步分析有别字的整句的内部情况。由于实验

所造句子都为两行长度，因此本部分不按照别字所在区域的第一行和第二行作为分类讨论。

4.3.1 平均注视时间

经过 SPSS 数据分析后，语言背景差异的主效应差异，F=4.068，P=0.044。语言水平差异的主效应显著，F=50.476，P=0.000。别字类型差异的主效应不显著，F=2.920，P=0.054。语言背景与语言水平的交叉效应显著，F=4.052，P=0.044。语言背景与别字类型的交叉效应不显著，F=0.475，P=0.622。语言水平与别字类型的交叉效应不显著，F=1.530，P=0.217。三者的交叉效应不显著，F=0.061，P=0.941。

由于语言背景与语言水平的交叉效应显著，因此对此进行简单分析。对于汉字圈学习者而言，初级水平学习者的平均注视时间显著大于高级水平学习者，P=0.000。对于非汉字圈学习者而言，初级水平学习者的平均注视时间同样显著大于高级水平学习者，P=0.000。对于初级水平学习者而言，汉字圈学习者与非汉字圈学习者之间的平均注视时间没有显著差异，P=0.998。对于高级水平学习者而言，汉字圈学习者的平均注视时间显著小于非汉字圈学习者，P=0.005。

4.3.2 总阅读时间

经过 SPSS 数据分析后，语言背景差异的主效应显著，F=0.443，P=0.506。语言水平差异的主效应显著，F=88.508，P=0.000。别字类型差异的主效应不显著，F=0.421，P=0.656。语言背景与语言水平的交叉效应显著，F=83.560，P=0.000。语言背景与别字类型的交叉效应不显著，F=0.842，P=0.431。语言水平与别字类型的交叉效应不显著，F=0.337，P=0.714。三者的交叉效应不显著，F=0.835，P=0.434。

由于语言背景与语言水平的交叉效应显著，因此对此进行简单分析。对于汉字圈学习者而言，初级水平学习者的总阅读时间显著大于高级水平学习者，P=0.000。对于非汉字圈学习者而言，初级水平学习者的总阅读时间与高级水平学习者之间没有显著差异，P=0.852。对于初级水平学习者内部而言，汉字圈学习者的总阅读时间显著大于非汉字圈学习者，P=0.000。对于高级水平学习者内部而言，汉字圈学习者的总阅读时间显著小于非汉字圈学习者，P=0.000。

4.3.3 总注视次数

经过 SPSS 数据分析后，语言背景差异的主效应显著，F=0.204，P=0.652。语言水平差异的主效应显著，F=64.614，P=0.000。别字类型差异的主效应不显著，F=0.083，P=0.921。语言背景与语言水平的交叉效应显著，F=65.018，P=0.000。语言背景与别字类型的交叉效应不显著，F=0.988，P=0.372。语言水平与别字类型的交叉效应不显著，F=0.344，P=0.709。三者的交叉效应不显著，F=0.785，P=0.456。

由于语言背景与语言水平的交叉效应显著，因为对此进行简单分析。对于汉字

圈学习者而言，初级水平学习者的总注视次数显著大于高级水平学习者，P=0.000。对于非汉字圈学习者而言，初级水平学习者的总注视次数与高级水平学习者之间没有显著差异，P=0.986。对于初级水平学习者内部而言，汉字圈学习者的总注视次数显著大于非汉字圈学习者，P=0.000。对于高级水平学习者内部而言，汉字圈学习者的总注视次数显著小于非汉字圈学习者，P=0.000。

5. 讨论

5.1 语言背景对别字识别的影响

5.1.1 语言背景对别字单字兴趣区识别的影响

1、语言背景对眼动早期指标的影响

（1）首次注视时间指标分析

对于别字兴趣区而言，由于语言背景主效应为不显著，因此我们可以认为对于不同语言背景的语言学习者而言，对于三类别字认知内部的早期加工均是一致的，即：不同语言背景的学习者，在认知的早期加工阶段，对汉字的音、形或形音的共同作用中没有一者处于主导地位。

（2）凝视时间指标分析

对于别字兴趣区而言，由于三者交叉效应显著，因此从数据中得出，汉字圈初级水平学生对同音异形、异音形似别字的凝视时间显著小于非汉字圈初级水平学生，汉字圈高级水平学生对同音异形、异音形似别字的凝视时间与非汉字圈高级水平学生之间无显著差异，因此可以得出：对于初级水平学生而言，汉字圈学生在认知的早期加工阶段对形码与音形结合的处理快于非汉字圈学生，而到高级水平时，两类语言背景学习者对形码与音形结合的处理认知速度保持一致。

汉字圈初级水平学生对同音异形别字的凝视时间与非汉字圈初级水平无显著差异，汉字圈高级水平学生对同音异形别字的凝视时间显著小于非汉字圈高级水平学生，因此可以得出：对于初级水平学生而言，汉字圈与非汉字圈学生在认知的早期加工阶段对音码的认知处理速度保持一致，但到高级水平时，汉字圈学生对音码的处理速度快于非汉字圈学生。前面的数据已说明汉字圈在初级或高级水平时对音码的处理速度未明显改变，所以非汉字圈学生随着汉语水平的提高，对音码的认知速度反而未变快。

综合早期阶段数据指标而言，在汉字认知的早期阶段，不同背景的学生对汉字的字音、字形、形音共同作用的首次注视次数加工速度都是一致的，没有出现显著差异。

但考虑到对别字单字可能会有多个注视点，因此采取凝视时间作为早期加工时间的最好指标。汉字圈初级水平学习者对字形的认知速度快于非汉字圈初级学习者，这是由于汉字圈学习者在学习汉语前，母语与汉语之间较为接近或在受教育阶段，接受过一定程度的汉字学习，虽然未接触到正规标准的汉字正音学习，但是对汉字字形有了认知的基础。因此，相对于非汉字圈初级学习者而言，汉字圈初级学习者对字形的认知速度更快。汉字圈学习者与非汉字圈学习者在高级水平阶段对汉字字形的认知速度保持一致，并且音形结合的认知速度也保持一致，这表明字形随语言水平的提高，对认知起到的作用越大。

2、语言背景对眼动晚期指标的影响

（1）注视次数指标分析

从语言背景与语言水平的交叉效应显著的数据中，我们发现初级水平汉字圈学生对三类别字的注视次数与初级水平非汉字圈学生无显著差异，高级水平汉字圈学生对三类别字的注视次数显著小于高级水平非汉字圈学生。因此，我们可以得出：后期加工过程中，语言背景并不影响学习者在初级水平时的加工速度，但却影响着学习者在高级水平时的加工速度，汉字圈高级水平学习者对别字的认知速度快于非汉字圈高级水平学习者。

从语言背景与别字类型的交叉效应显著的内部数据中，我们发现当阅读同音异形与异音形似别字，汉字圈与非汉字圈学生的注视次数没有显著差异，因此我们可以认为：汉字圈与非汉字圈学生无论处于初级水平抑或是高级水平，在认知的后期阶段，两类学生对字音和字形的认知速度没有显著差异。非汉字圈学生阅读同音形似别字时，注视次数显著大于汉字圈学习者与母语者，因此得出结论：音与形的共同作用对非汉字圈学习者在后期认知过程中干扰性最大。

（2）总注视时间指标分析

从语言背景与别字类型的交叉效应显著的数据中，当阅读同音形似与同音异形别字时，非汉字圈学习者的总注视时间显著大于汉字圈学习者与母语者；当阅读异音形似别字时，母语者的总注视时间显著小于非汉字圈学习者与汉字圈学习者。因此，可以得到结论：汉字圈与非汉字圈学习者在汉字识别的后期阶段，对汉字字形的认知速度保持一致。但汉字圈学习者在汉字识别的后期阶段，对汉字字音以及字音与字形结合的识别速度快于非汉字圈学习者。

（3）回视路径时间指标分析

从语言背景与别字类型的交叉效应显著的数据中，当阅读同音形似与同音异形别字时，非汉字圈学习者的回视路径时间显著大于汉字圈学习者与母语者；当阅读异音形似别字时，母语者的回视路径时间显著小于非汉字圈学习者与汉字圈学习者。因此，可以得到结论：汉字圈与非汉字圈学习者在汉字识别的后期阶段，对汉字字

形的认知速度保持一致。但汉字圈学习者在汉字识别的后期阶段，对汉字字音以及字音与字形结合的识别速度快于非汉字圈学习者。

综合后期阶段眼动指标，由于总注视时间与回视路径时间的结论基本保持一致，因此可以认为其代表汉语学习者在认知后期阶段的阅读心理图式。非汉字圈学习者对三者的后期认知速度一致，其中字形的认知速度与汉字圈没有显著差距，表示汉语学习者在后期认知阶段中，无论语言背景，到达汉语高级水平以后，形码与语义的联结会稳定在一个阶段。

5.1.2 语言背景对别字所在词语兴趣区识别的影响

1、语言背景对眼动早期指标的影响

（1）首次注视时间指标分析

由于语言背景主效应不显著，因此表明不同语言背景阅读者在识别别字所在词语兴趣区时的识别速度并无显著差异，

（2）凝视时间指标分析

从语言背景因素主效应显著的数据中可以得出，当阅读包含别字的词语时，语言背景很大程度地影响凝视时间，汉字圈学习者对别字词语的认知速度显著快于非汉字圈学习者的速度。

综合早期眼动指标而言，考虑到对别字单字可能会有多个注视点，因此采取凝视时间作为早期加工时间的最好指标。因此，对于别字所在词语识别过程中，语言背景影响着阅读者的识别速度，汉字圈学习者的识别速度显著快于非汉字圈学习者。

2、语言背景对眼动晚期指标的影响

（1）注视次数指标分析

从语言背景与语言水平的交叉效应显著的数据中可以得出，无论在初级或高级水平，汉字圈学习者的识别速度都显著小于非汉字圈学习者，表明汉字圈学习者的识别速度在对词语识别的后期阶段，快于非汉字圈学习者。

从语言背景与别字类型的交叉效应显著的数据可以得出，在阅读同音形似别字时，母语者的注视次数显著小于汉字圈与非汉字圈学习者，汉字圈与非汉字圈之间无显著差异；在阅读同音异形别字时，母语者的注视次数显著小于汉字圈学习者，且汉字圈学习者的注视次数显著小于非汉字圈学习者；在阅读异音形似别字时，三者之间并无显著差异。因此表示三类阅读者在识别的后期阶段，对字形、音形结合的识别速度没有显著差异，汉字圈学习者对字音的识别速度快于非汉字圈学习者，母语者对音形结合的识别速度快于汉字圈学习者与非汉字圈学习者。

（2）总注视时间指标分析

从语言背景和语言水平交叉效应显著的数据中得出，汉字圈初级水平学习者的总注视时间显著小于非汉字圈初级水平学习者的总注视时间，汉字圈高级水平学习者的总注视时间显著小于非汉字圈高级水平学习者。这表明汉字圈学习者在后期别字识别阶段，对别字所在词语的识别速度一致快于非汉字圈学习者。

从语言背景与别字类型交叉效应显著的数据中，在阅读同音形似别字所在词语时，母语者的总注视时间显著小于汉字圈与非汉字圈学习者，汉字圈与非汉字圈学习者之间没有显著差异。在阅读同音异形别字所在词语时，母语者的总注视时间显著小于汉字圈学习者，汉字圈学习者的总注视时间又显著小于非汉字圈学习者。在阅读异音形似别字所在词语时，母语者的总注视时间显著小于非汉字圈学习者，汉字圈学习者的总注视时间与母语者、汉字圈学习者均无显著差异。这表明在认知的后期阶段，语言背景对别字词语中的字形、音形结合的认知没有起到显著影响。但语言背景对别字词语中字音的影响起到了影响，汉字圈学习者对字音的识别速度快于非汉字圈学习者。

（3）回视路径时间指标分析

从语言背景与语言水平的交叉效应显著的数据中得出，汉字圈初级水平学习者的回视路径时间显著小于非汉字圈初级水平学习者，汉字圈高级水平学习者的回视路径时间也显著小于非汉字圈高级水平学习者。这表明：无论于什么水平阶段，非汉字圈学习者的识别速度都慢于汉字圈学习者。

从语言背景与别字类型的交叉效应显著的数据中得出，在阅读同音形似别字词语时，母语者的回视路径时间显著小于汉字圈与非汉字圈学习者，后两者之间没有显著差异。在阅读同音异形别字词语时，母语者的回视路径时间显著小于汉字圈学习者，汉字圈学习者的回视路径时间又显著小于非汉字圈学习者。在阅读异音形似别字词语时，母语者的回视路径时间显著小于非汉字圈学习者，汉字圈学习者的回视路径时间与母语者、非汉字圈学习者无显著差异。我们可以得出结论：在阅读别字词语的后期阶段，针对字形的认知速度，汉字圈初级水平学习者与非汉字圈初级水平学习者的回视路径时间没有显著差异，而汉字圈高级水平学习者的回视路径时间显著小于非汉字圈高级水平学习者，即汉字圈与非汉字圈学习者在初级水平时，对字形的认知没有快慢之分，而到高级水平时，汉字圈学习者的认知结构中，字形起到更主导的作用。

综合后期眼动指标而言，汉字圈学习者在不同水平的识别速度都快于非汉字圈学习者。在认知的后期阶段，语言背景对别字词语中的字形、音形结合的认知没有起到显著影响。但语言背景对别字词语中字音的影响起到了影响，汉字圈学习者对字音的识别速度快于非汉字圈学习者。

5.1.3 语言背景对整句识别的影响

1、语言背景对平均注视时间指标的影响

从语言背景与语言水平交叉效应显著的数据中可以得出，汉字圈初级水平学习者的平均注视时间与非汉字圈学习者没有显著差异，汉字圈高级水平学习者的平均注视时间显著小于非汉字圈学习者。这表明汉字圈学习者与非汉字圈学习者在初级水平时，对于有别字的整句的平均注视时间没有显著差异。但在高级水平时，汉字圈学习者对别字所在整句的识别显著快于非汉字圈学习者。这表明，语言背景对整句的识别起到影响，汉字圈学习者在高级水平时因为语言迁移的原因对含有别字的别字识别更快。

2、语言背景对总阅读时间指标的影响

从语言背景与语言水平交叉效应显著的数据中可以得出，汉字圈初级水平学习者的总阅读时间显著大于非汉字圈初级水平学习者，汉字圈高级水平学习者的总阅读时间显著小于非汉字圈高级水平学习者。这表明汉字圈学习者在初级水平时，对汉字的字音、字形的识别更加关注，通过增加整句除别字之外的阅读时间以提高对汉字的认知准确性。非汉字圈学习者在初级水平时，由于对汉字的认知可能稍微弱于汉字圈学习，并出于简化的学习策略减少对语句的判断，因此对整句的阅读时间会少一些。而当汉字圈学习者处于高级水平时，由于语言水平的提高，对汉字的认知便会逐渐稳定和固化，因此会快于非汉字圈学习者。

3、语言背景对总注视次数指标的影响

从语言背景与语言水平交叉效应显著的数据中可以得出，汉字圈初级水平学习者的总注视次数显著大于非汉字圈初级水平学习者，汉字圈高级水平学习者的总注视次数显著小于非汉字圈高级水平学习者。这与上文中总阅读时间指标分析的结论一致，汉字圈学习者在初级水平时，对汉字的字音、字形的识别更加关注，通过增加注视次数以提高对汉字的认知准确性。非汉字圈学习者在初级水平时，由于对汉字的认知可能稍微弱于汉字圈学习者，因此对别字或整句的注视次数多一些。而当汉字圈学习者处于高级水平时，由于语言水平的提高，对字形的认知便会逐渐稳定和固化，因此会快于非汉字圈学习者。

综合整句的眼动指标来看，语言背景对整句识别产生重要影响，汉字圈学习者在高级水平时，都显示出识别速度快于非汉字圈学习者。但在初级水平时，语言背景因素产生的效果不尽相同。从整体的平均注视时间而言，汉字圈与非汉字圈学习者之间无显著差异；但从总注视时间与次数来看，汉字圈学习者对整句更为关注，通过增加相应的阅读注视次数与总阅读时间来确认别字的正确性。这反而表明，汉字圈初级水平学习者对汉字的具体结构记忆更为清晰。

5.2 语言水平对别字识别的影响

5.2.1 语言水平对别字单字兴趣区的影响

1、语言水平对眼动早期指标的影响

（1）首次注视时间指标分析

由于语言水平主效应不显著，因此我们认为对于处于初级水平或高级水平的学习者，对别字的认知内部的早期加工是一致的，即：不同水平的汉语学习者，在认知的早期加工阶段，对汉字的音、形或形音的共同作用中并未随着语言水平的变化而变化。

（2）凝视时间指标分析

从数据可得知，来自汉字圈背景的学生在初级以及高级水平时分别对三类别字的凝视时间没有显著差异，并且两种水平学生相互之间也无显著差异，即表明：汉字圈学习者随着汉语水平的提高，对音、形的认知速度并没有显著提升。

但对于非汉字圈学习者内部而言，语言水平对其认知别字的速度起着重要影响，语言水平的高低与非汉字圈学习者对音形结合的认知速度呈正比关系，与非汉字圈学习者对字音的认知速度呈反比关系，与非汉字圈学习者对字形的认知速度无关系。

综合早期阶段数据指标而言，我们考虑到对别字单字可能会有多个注视点，因此采取凝视时间作为早期加工时间的最好指标。首先，语言水平因素对汉字圈学习者的别字识别不起作用，随着汉语水平的提高，汉字圈学习者对音、形的认知速度未有显著提高。其次，语言水平因素对于非汉字圈学习者的别字中字音、音形结合识别起到部分作用，但对别字中的字形认知未起到显著作用。

2、语言水平对眼动晚期指标的影响

（1）注视次数指标分析

从语言背景与语言水平的交叉效应显著的数据中，对于来自汉字圈的学生而言，初级水平学生对三类别字的注视次数显著高于高级水平学生；对于来自非汉字圈的学生而言，初级水平学生与高级水平学生之间没有显著差异。因此，我们可以得出：来自汉字圈的汉语学习者随着自身汉语水平的提高，对别字的注视次数呈现下降趋势，即在汉字识别的后期加工阶段，汉字圈学习者对别字的认知速度随着水平的提高而加快。而来自非汉字圈的汉语学习者随着汉语水平的提高，对别字的注视次数没有呈现明显趋势变化，即在汉字识别的后期加工阶段，非汉字圈学习者对别字的认知速度并不随着水平的变化而变化。

（2）总注视时间指标分析

从语言水平差异显著的数据中，我们发现初级水平学习者对三类别字的总注视时间显著大于高级水平学习者，高级水平学习者的总注视时间显著大于母语者。表明语言水平影响着在汉字的后期认知阶段，母语者对别字的认知速度快于高级水平学习者，并快于初级水平学习者。

（3）回视路径时间指标分析

从语言水平差异显著的数据中，我们发现初级水平学习者对三类别字的回视路径时间显著大于高级水平学习者，并且高级水平学习者对三类别字的回视路径时间又显著大于母语者。这同时表明，在汉字的后期认知阶段，初级学习者对别字的认知速度慢于高级水平学习者，而高级水平学习者则慢于母语者。

综合后期阶段眼动指标，汉字识别的后期加工阶段，汉字圈与非汉字圈学习者对别字的认知速度随着语言水平的提高而加快。但非汉字圈学习者对别字的认知加工负荷并没有随着语言水平的提高而减小。并且对于汉语学习者而言，随着汉语水平的提高，在汉字认知的后期阶段，其对汉字的字音与字形的认知加工负荷并没有显著减小。汉语学习者随着汉语水平的提高，在汉字认知的后期阶段，对音形结合的认知加工负荷随之显著减小。

5.2.2 语言水平对别字所在词语兴趣区识别的影响

1、语言水平对眼动早期指标的影响

（1）首次注视时间指标分析

由于语言水平主效应不显著，因此我们可以认为对于不同语言水平的阅读者而言，在早期认知阶段，对三类别字词语的认知加工均是一致的，无显著差异。

（2）凝视时间指标分析

从语言水平因素主效应显著的数据中得出，语言水平影响着阅读者对别字词语的早期识别速度，母语者对别字词语的识别速度显著快于高级水平学习者，高级水平学习者对别字词语的认知速度同样显著快于初级水平学习者的速度。

综合早期眼动指标而言，我们考虑到对别字单字可能会有多个注视点，因此采取凝视时间作为早期加工时间的最好指标。语言水平影响着阅读者对别字所在词语的认知速度，其中高级水平学习者的速度显著快于初级水平学习者。

2、语言水平对眼动晚期指标的影响

（1）注视次数指标分析

从语言背景与语言水平的交叉效应显著的数据中可以得出，汉字圈初级水平学习者的注视次数显著大于汉字圈高级水平学习者，非汉字圈初级水平学习者的注视次数与非汉字圈高级水平学习者差异不显著，因此可以认为汉字圈学习者随着语言水平的提高，其在认知的后期阶段，对音、形或音形结合的认知速度都有显著增速，而非汉字圈学习者对三者的识别速度并没有随着语言水平的提升而变快。

（2）总注视时间指标分析

从语言背景和语言水平交叉效应显著的数据中得出，汉字圈初级水平学习者的总注视时间显著大于汉字圈高级水平学习者，非汉字圈初级水平学生的总注视时间与非汉字圈高级水平学习者没有显著差异。这表明汉字圈学习者随着语言水平的提高，其在认知的后期阶段，对音、形或音形结合的认知速度都有显著增速，而非汉字圈学习者对三者的识别速度并没有随着语言水平的提升而变快。

（3）回视路径时间指标分析

从语言背景汉与语言水平的交叉效应显著的数据中得出，对于汉字圈内部而言，高级水平学习者的回视路径时间显著小于初级水平学习者。对于非汉字圈内部而言，初级水平与高级水平学习者之间的回视路径时间没有显著差异。这表明汉字圈学习者随着语言水平的提高，其在认知的后期阶段，对音、形或音形结合的认知速度都有显著增速，而非汉字圈学习者对三者的识别速度并没有随着语言水平的提升而变快。

综合后期眼动指标而言，语言水平因素对汉字圈学习者识别别字的后期认知过程的速度起到影响，汉字圈学习者识别速度与语言水平呈现正相关。然而语言水平因素对非汉字圈学习者识别别字的后期认知过程的速度并无影响，与之没有关系。

5.2.3 语言水平对整句识别的影响

1、语言水平对平均注视时间指标的影响

从语言背景与语言水平交叉效应显著的数据中可以得出，两类语言背景学习者在初级水平时的平均注视时间都显著大于高级水平。这表明语言水平对整句识别中起到重要影响，初级水平学习者对含有别字的整句识别的速度都小于高级水平学习者的识别速度。

2、语言水平对总阅读时间指标的影响

从语言背景与语言水平交叉效应显著的数据中可以得出，汉字圈初级水平学习者的总阅读时间显著小于高级水平学习者，非汉字圈初级与高级水平的总阅读时间差异不显著。这表明语言水平因素对汉字圈学习者内部的整句识别具有显著影响，

但对非汉字圈学习者内部无显著影响。

3、语言水平对总注视次数指标的影响

从语言背景与语言水平交叉效应显著的数据中可以得出，汉字圈初级水平学习者的的总注视次数显著小于高级水平学习者，非汉字圈初级与高级水平的总注视次数差异不显著，这与上文中总阅读时间指标分析的结论一致。语言水平因素对汉字圈学习者内部的整句识别具有显著影响，但对非汉字圈学习者内部无显著影响。

综合整句的眼动指标而言，语言水平因素对汉字圈学习者有显著影响，汉字圈学习者会随着语言水平的提高，而加快对整句的识别速度。但语言水平因素对非汉字圈学习者没有显著影响，非汉字圈学习者对整句的识别速度并不会随着语言水平的提高而呈现正向发展。

5.3 别字类型对别字识别的影响

5.3.1 别字类型对别字单字兴趣区识别的影响

1、字音激活（同音异形别字）对眼动早期指标的影响

（1）首次注视时间指标分析

由于别字类型主效应不显著，因此我们可以认为对于汉语阅读者而言，对于三类别字的认知内部的早期加工均是一致的。即：即：不同的学习者，在认知的早期加工阶段，字音激活并未起到显著作用，并且其在汉字的音、形或形音的共同作用中没有处于主导地位。

（2）凝视时间指标分析

对于别字兴趣区指标而言，由于三者交叉效应显著，从数据中得出，来自汉字圈背景的学生在初级以及高级水平时分别对三类别字的凝视时间没有显著差异，即表明：对于汉字圈的学生而言，处于初级水平或高级水平，在认知的早期加工阶段，字音激活并未起到显著作用，其在汉字的音、形或形音的共同作用中未处于主导地位。并且母语者在阅读三类别字时的凝视时间内部差异也不显著，则可以认为汉字圈学生在早期阶段对汉字的认知与母语者的加工方式类似。

而非汉字圈初级水平学生对同音异形别字的凝视时间显著小于同音形似别字，但与异音形似别字的凝视时间之间无显著差异。因此可以推断，对于非汉字圈初级水平学生而言，在认知的早期加工阶段，字音激活的作用与字形激活之间无显著差异，但却快于字音、字形共同激活起到的速度。

非汉字圈高级水平学生对同音异形别字的凝视时间显著大于其他两类别字，因

此可以推断，对于非汉字圈高级水平学生而言，在认知的早期加工阶段，与字形、音形结合激活相比，更不依赖字音的作用激活汉字认知。

综合早期阶段数据指标而言，我们考虑到对别字单字可能会有多个注视点，因此采取凝视时间作为早期加工时间的最好指标。字音激活效应在汉字圈学习者内部与母语者的早期激活过程中与其他相比，不起显著作用。但对于非汉字圈学习者而言，其在初级水平时较音形结合共同作用，更多依赖字音作用；其在高级水平时，却最不依赖字音的作用。

2、字音激活（同音异形别字）对眼动晚期指标的影响

（1）注视次数指标分析

从语言背景与别字类型的交叉效应显著的内部数据中，我们发现汉字圈学生阅读同音异形别字的注视次数显著小于异音形似别字，并且与同音形似别字之间并无显著差异。非汉字圈学生阅读同音异形别字的注视次数显著小于其他两类别字的注视次数，而母语者对三类别字的注视次数内部没有显著差异。这表明，在汉字认知的后期阶段，字音激活在汉字圈学习者的认知过程中起到的作用强于字形激活，与音形结合激活无异。并且字音激活在非汉字圈学习者的认知过程中强于字形与音形结合作用，起着最大的作用。

（2）总注视时间指标分析

从语言背景与别字类型的交叉效应显著的数据中，我们发现汉字圈学习者阅读同音异形别字的总注视时间与其他两类别字无显著差异。并且非汉字圈学习者与母语者对三类别字的总注视时间无显著差异。这表明汉语学习者在汉字认知的后期阶段，字音激活的效应与字形以及音形共同作用的激活并无显著差异，无一处于主导地位。

（3）回视路径时间指标分析

从语言背景与别字类型的交叉效应显著的数据中，我们发现汉字圈学习者阅读同音异形别字的回视路径时间与其他两类别字无显著差异。并且非汉字圈学习者与母语者对三类别字的回视路径时间无显著差异。这表明汉语学习者在汉字认知的后期阶段，字音激活的效应与字形以及音形共同作用的激活并无显著差异，无一处于主导地位。

综合后期阶段眼动指标，注视次数的多少可以反应阅读的加工负荷。因此，汉语学习者对字音激活相较于字形激活更可以减轻阅读的加工负荷，帮助阅读者更好地进行阅读。总注视时间与回视路径时间代表着汉语学习者在认知后期阶段的心理图式。字音激活对于汉语学习者而言，在后期认知过程之中不起主导作用。

3、字音、字形共同激活（同音形似别字）对眼动早期指标的影响

（1）首次注视时间指标分析

由于别字类型主效应不显著，因此我们可以认为对于汉语阅读者而言，对于三类别字的认知内部的早期加工均是一致的。即：即：不同的学习者，在认知的早期加工阶段，字音、字形共同激活并未起到显著作用，并且其在汉字的音、形或形音的共同作用中没有处于主导地位。

（2）凝视时间指标分析

对于别字兴趣区指标而言，由于三者交叉效应显著，从数据中得出，来自汉字圈背景的学生在初级以及高级水平时分别对三类别字的凝视时间没有显著差异，即表明：对于汉字圈的学生而言，处于初级水平或高级水平，在认知的早期加工阶段，字音、字形共同激活并未起到显著作用，其在汉字的音、形或形音的共同作用中未处于主导地位。并且母语者在阅读三类别字时的凝视时间内部差异也不显著，则可以认为汉字圈学生在早期阶段对汉字的认知与母语者的加工方式类似。

而非汉字圈初级水平学生对同音形似别字的凝视时间显著大于同音异形别字与异音形似别字。因此可以推断，对于非汉字圈初级水平学生而言，在认知的早期加工阶段，形音的共同作用并未起到帮助认知的作用，反而起到了较大的干扰作用。

非汉字圈高级水平学生对同音形似别字的凝视时间显著小于同音异形别字，与异音形似别字的凝视时间无显著差异，因此可以推断，对于非汉字圈高级水平学生而言，在认知的早期加工阶段，相比于字音激活，学习者更依赖于音形共同激活作用。

综合早期数据指标而言，我们考虑到对别字单字可能会有多个注视点，因此采取凝视时间作为早期加工时间的最好指标。音形结合共同作用的效应在汉字圈学习者内部与母语者的早期激活过程中与其他相比，不起显著作用。但对于非汉字圈学习者而言，其在初级水平时音形共同激活起到了较大的干扰作用；其在高级水平时，却依赖于音形共同作用。

4、字音、字形共同激活（同音形似别字）对眼动晚期指标的影响

（1）注视次数指标分析

从语言背景与别字类型的交叉效应显著的内部数据中，我们发现汉字圈学生阅读同音形似别字的注视次数显著小于异音形似别字，并且与同音异形别字之间并无显著差异。非汉字圈学生阅读同音形似别字的注视次数显著大于同音异形别字，并且与异音形似别字无显著差异，而母语者对三类别字的注视次数内部没有显著差异。这表明，在汉字认知的后期阶段，音形结合激活在汉字圈学习者的认知过程中起到

的作用强于字形激活，与字音激活无异。并且音形结合作用在非汉字圈学习者的认知过程中弱于字音激活，与字形激活之间无显著差异。

（2）总注视时间指标分析

从语言背景与别字类型的交叉效应显著的数据中，我们发现汉字圈学习者阅读同音形似别字的总注视时间短于异音形似别字，且与同音异形别字之间无显著差异。非汉字圈学习者与母语者对三类别字的总注视时间无显著差异。这表明汉字圈学习者在汉字认知的后期阶段，音形共同激活的作用强于字形激活作用，但与字音激活作用无显著差异。非汉字圈学习者及母语者对汉字认知的后期阶段中，音形结合作用并未起到显著作用，并且其在汉字的音、形或形音的共同作用中没有处于主导地位。

（3）回视路径时间指标分析

从语言背景与别字类型的交叉效应显著的数据中，我们发现汉字圈学习者阅读同音形似别字的回视路径时间短于异音形似别字，且与同音异形别字之间无显著差异。非汉字圈学习者与母语者对三类别字的回视路径时间无显著差异。这表明汉字圈学习者在汉字认知的后期阶段，音形共同激活的作用强于字形激活作用，但与字音激活作用无显著差异。非汉字圈学习者及母语者对汉字认知的后期阶段中，音形结合作用并未起到显著作用，并且其在汉字的音、形或形音的共同作用中没有处于主导地位。

综合后期阶段眼动指标，注视次数的多少可以反应阅读的加工负荷。因此，汉语学习者对音形共同作用的激活相较于字形激活更可以减轻阅读的加工负荷，帮助阅读者更好地进行阅读。总注视时间与回视路径时间代表着汉语学习者在认知后期阶段的心理图式。音形共同作用激活对于汉字圈学习者而言，强于字形激活；对于非汉字圈学习者而言，其在三者作用中未起到主导作用。

5、字形激活（异音形似别字）对眼动早期指标的影响

（1）首次注视时间指标分析

由于别字类型主效应不显著，因此我们可以认为对于汉语阅读者而言，对于三类别字的认知内部的早期加工均是一致的。即：即：不同的学习者，在认知的早期加工阶段，字形激活并未起到显著作用，并且其在汉字的音、形或形音的共同作用中没有处于主导地位。

（2）凝视时间指标分析

对于别字兴趣区指标而言，由于三者交叉效应显著，从数据中得出，来自汉字圈背景的学生在初级以及高级水平时分别对三类别字的凝视时间没有显著差异，即

表明：对于汉字圈的学生而言，处于初级水平或高级水平，在认知的早期加工阶段，字形激活并未起到显著作用，其在汉字的音、形或形音的共同作用中未处于主导地位。并且母语者在阅读三类别字时的凝视时间内部差异也不显著，则可以认为汉字圈学生在早期阶段对汉字的认知与母语者的加工方式类似。

而非汉字圈初级水平学生对异音形似别字的凝视时间显著小于同音形似别字，但与同音异形别字的凝视时间之间无显著差异。因此可以推断，对于非汉字圈初级水平学生而言，在认知的早期加工阶段，字形激活的作用与字音激活之间无显著差异，但却快于字音、字形共同激活起到的速度。

非汉字圈高级水平学生对异音形似别字的凝视时间显著小于同音异形别字，与同音形似别字的凝视时间无显著差异，因此可以推断，对于非汉字圈高级水平学生而言，在认知的早期加工阶段，相比于字音激活，学习者更依赖于字形激活作用。

非汉字圈初级水平学生在认知的早期加工阶段，对汉字的认知识别主要依赖字形的作用。

综合早期数据指标而言，我们考虑到对别字单字可能会有多个注视点，因此采取凝视时间作为早期加工时间的最好指标，字形激活效应在汉字圈学习者内部与母语者的早期激活过程中与其他相比，不起显著作用。但对于非汉字圈学习者而言，其在初级水平时字形激活起到了正向作用，并与字音激活无差异；其在高级水平时，依旧依赖于字形激活，但比起字音起到更主导的作用。

6、字形激活（异音形似别字）对眼动晚期指标的影响

（1）注视次数指标分析

从语言背景与别字类型的交叉效应显著的内部数据中，我们发现汉字圈学生阅读异音形似别字的注视次数显著大于其他两类别字。非汉字圈学生阅读异音形似别字的注视次数显著大于同音异形别字，并且与同音形似别字无显著差异，而母语者对三类别字的注视次数内部没有显著差异。这表明，在汉字认知的后期阶段，字形激活在汉字圈学习者的认知过程中起到的作用弱于字音与音形结合，起到的更多为干扰作用。并且字形作用在非汉字圈学习者的认知过程中弱于字音激活，与音形结合共同作用激活之间无显著差异。

（2）总注视时间指标分析

从语言背景与别字类型的交叉效应显著的数据中，我们发现汉字圈学习者对异音形似别字的总注视时间长于同音形似别字，与同音异形别字之间并无显著差异。非汉字圈学习者与母语者对三类别字的总注视时间无显著差异。这表明汉字圈学习者在汉字认知的后期阶段，字形激活的作用弱于音形共同作用，但与字音激活作用无显著差异。非汉字圈学习者及母语者对汉字认知的后期阶段中，字形激活作用并

未起到显著作用，并且其在汉字的音、形或形音的共同作用中没有处于主导地位。

（3）回视路径时间指标分析

别字类型对别字所在对于别字兴趣区而言，从语言背景与别字类型的交叉效应显著的数据中，我们发现汉字圈学习者对异音形似别字的回视路径时间长于同音形似别字，与同音异形别字之间并无显著差异。非汉字圈学习者与母语者对三类别字的回视路径时间无显著差异。这表明汉字圈学习者在汉字认知的后期阶段，字形激活的作用弱于音形共同作用，但与字音激活作用无显著差异。非汉字圈学习者及母语者对汉字认知的后期阶段中，字形激活作用并未起到显著作用，并且其在汉字的音、形或形音的共同作用中没有处于主导地位。

综合后期阶段眼动指标，注视次数的多少可以反应阅读的加工负荷。因此，汉语学习者对字形激活相较于字音激活或音形共同作用的激活更会增加阅读的加工负荷，对阅读效果起到干扰作用。总注视时间与回视路径时间代表着汉语学习者在认知后期阶段的心理图式。字形激活对于汉字圈学习者而言，弱于音形共同作用，与字音激活无显著差异；对于非汉字圈学习者而言，其在三者作用中未起到主导作用

5.3.2 别字类型对别字所在词语兴趣区识别的影响

1、字音激活（同音异形别字）对眼动早期指标的影响

（1）首次注视时间指标分析

从别字类型差异主效应显著的数据中，我们发现同音异形别字的首次注视时间显著大于异音形似别字，与同音形似别字之间无显著差异。这表明无关语言背景与语言水平，阅读者在早期认知阶段，当阅读别字所在词语时，字音激活的速度慢于字形激活速度，但与音形结合作用之间无差异，即字音在别字词语认知的早期加工过程中，并未处于主导地位，而在字形之下。

（2）凝视时间指标分析

从别字类型主效应显著的数据中，我们发现汉语阅读者对同音异形别字所在词语的凝视时间显著小于异音形似别字，与同音形似别字之间无显著差异。这表明汉语阅读者对别字所在词语的早期识别过程中，字音的激活效应显著强于字形、与音形结合作用无差距。

2、字音激活（同音异形别字）对眼动晚期指标的影响

（1）注视次数指标分析

从别字类型主效应显著的数据可以得出，同音异形别字所在词语兴趣区的注视

次数显著小于异音形似别字，与同音形似别字无显著差异，这表明在识别词语的后期阶段中，汉语阅读者对字音激活的速度快于字形激活，与音形结合识别速度无显著差异，即相较于字形，汉语阅读者更依赖字音激活的作用。

（2）总注视时间指标分析

从别字类型因素主效应显著的数据中可以得出，汉语阅读者阅读同音异形别字所在词语兴趣区的总注视时间显著小于异音形似别字的总注视时间，与同音形似别字之间无显著差异。这表明：汉语学习者在认知的后期阶段，字音激活的速度显著强于字形激活的速度，但与音形结合作用的速度无差异。

这表明汉语阅读者在认知的后期阶段，字音激活的速度显著小于字形激活的速度。并且汉字圈学习者的识别结构中，字音激活的速度与音形结合激活的速度处于较为平等的地位。非汉字圈学习者的识别结构中，字音激活依旧弱于音形结合作用的激活速度。

（3）回视路径时间指标分析

从别字类型差异显著的数据中得出，同音异形别字所在词语兴趣区的回视路径时间显著小于异音形似别字，与同音形似别字之间无显著差异。这表明，在汉语阅读者的后期识别过程中，字音激活速度强于字形激活效应，与音形结合作用之间无差异，即字音激活相比字形激活起到更主导的后期辅助识别的作用。

这表明，汉字圈阅读者在词语认知的后期阶段中，字音激活的速度显著小于字形激活的速度。并且汉字圈学习者的识别结构中，字音激活的速度与音形结合激活的速度处于较为平等的地位。非汉字圈学习者的识别结构中，字音激活依旧弱于音形结合作用的激活速度。

结合后期眼动指标而言，注视次数的多少可以反应阅读的加工负荷。总注视时间与回视路径时间代表着汉语学习者在认知后期阶段的心理图式。并且结合字音激活在别字单字兴趣区中所起到的作用，其在后期识别过程中字音并未起到主导作用，这产生的原因由于单字形码与语义的联结认知负荷虽然最小，但由于不确定，处于对词语其他单字的确认，联合确认语义，从而导致后期认知时间的增加。

3、字音、字形共同激活（同音形似别字）对眼动早期指标的影响

（1）首次注视时间指标分析

从别字类型差异显著的数据中，我们发现同音形似别字的首次注视时间显著大于异音形似别字，与同音异形别字之间无显著差异。这表明无关语言背景与语言水平，阅读者在早期认知阶段，当阅读别字所在词语时，音形共同作用的激活速度慢于字形激活速度，但与字音激活之间无差异，即音形共同作用在别字词语认知的早

期加工过程中，并未处于主导地位，而在字形之下。

（2）凝视时间指标分析

从别字类型主效应显著的数据中，我们发现汉语阅读者对同音形似别字所在词语的凝视时间显著小于异音形似别字，与同音异形别字之间无显著差异。这表明汉语阅读者对别字所在词语的早期识别过程中，音形结合作用的激活效应显著强于字形、与字音激活无差距。

综合早期眼动指标而言，我们考虑到对别字单字可能会有多个注视点，因此采取凝视时间作为早期加工时间的最好指标。音形结合激活强于字形。

4、字音、字形共同激活（同音形似别字）对眼动晚期指标的影响

（1）注视次数指标分析

从别字类型主效应显著的数据可以得出，同音形似别字所在词语兴趣区的注视次数显著小于异音形似别字，与同音异形别字无显著差异，这表明在识别词语的后期阶段中，汉语阅读者对音形结合激活的速度快于字形激活，与字音激活速度无显著差异，即相较于字形，汉语阅读者更依赖音形结合激活的作用。

（2）总注视时间指标分析

从别字类型因素主效应显著的数据中可以得出，汉语阅读者阅读同音形似别字所在词语兴趣区的总注视时间显著小于异音形似别字，与同音异形别字之间无显著差异。这表明：汉语学习者在认知的后期阶段，音形共同作用激活的速度显著强于字形激活的速度，但与字音激活的速度无差异。

这表明在汉字圈学习者的后期识别结构中，音形结合激活的速度与字音激活的速度处于较为平等的地位，但却慢于字形激活的速度。非汉字圈学习者的后期识别结构中，音形结合作用的激活速度强于字音激活速度，与字形激活速度无差异，处于较为平等的位置。

（3）回视路径时间指标分析

从别字类型差异显著的数据中得出，同音形似别字所在词语兴趣区的回视路径时间小于异音形似别字，与同音形似别字之间无显著差异。这表明，在汉语阅读者的后期识别过程中，音形结合作用的激活强于字形激活效应，与字音激活作用之间无差异，即音形结合激活作用相比字形激活起到更主导的后期辅助识别的作用。

这表明，汉语阅读者在别字词语认知的后期阶段，音形结合激活的速度都小于字形的激活速度。但对于汉字圈学习者而言，音形结合的识别速度与字音激活之间

无显著差异。对于非汉字圈学习者而言，音形结合的识别速度却显著快于字音激活速度。

结合后期眼动指标而言，注视次数的多少可以反应阅读的加工负荷。总注视时间与回视路径时间代表着汉语学习者在认知后期阶段的心理图式。对于别字所在词语兴趣区而言，无论是加工负荷抑或是后期加工过程中，汉语阅读者对音形结合作用激活的速度都显著快于字形激活。

5、字形激活（异音形似别字）对眼动早期指标的影响

（1）首次注视时间指标分析

从别字类型差异显著的数据中，我们发现异形形似别字的首次注视时间显著小于同音形似别字与同音异形别字，这表明无关语言背景与语言水平，阅读者在早期认知阶段，当阅读别字所在词语时，对字形的识别速度快于对字音与音形结合的识别速度，即字形在别字词语认知的早期加工过程中，处于上层主导地位。

（2）凝视时间指标分析

从别字类型主效应显著的数据中，我们发现阅读者对异音形似别字的凝视时间显著大于同音形似、同音异形别字，这表明字形激活的速度显著小于字音激活与音形结合激活。这与阅读单别字的凝视时间的数据有所差异，但由于分析的数据为别字所在词语，因此可以认为阅读者对异音形似的部分注意力转移到词语中的其他汉字上，以便确认别字在词语中的正确意义。

综合早期眼动指标而言，我们考虑到对别字单字可能会有多个注视点，因此采取凝视时间作为早期加工时间的最好指标。

6、字形激活（异音形似别字）对眼动晚期指标的影响

（1）注视次数指标分析

从别字类型主效应显著的数据可以得出，异音形似别字的注视次数显著大于同音异形别字与同音形似别字，这表明在识别词语的后期阶段中，阅读者对字形激活的速度慢于字音激活与音形结合激活的作用，即字形在认知模型中不再处于主导作用。

（2）总注视时间指标分析

从别字类型因素主效应显著的数据中可以得出，汉语阅读者阅读异音形似别字所在词语兴趣区的总注视时间显著大于同音形似与同音异形别字。这表明：汉语学习者在认知的后期阶段，字形的激活速度显著弱于字音激活速度与音形结合作用的

速度。

（3）回视路径时间指标分析

从别字类型差异显著的数据中得出，异音形似别字词语的回视路径时间显著大于同音形似与同音异形别字词语，后两者之间没有显著差异。这表示，在阅读者的后期识别过程中，字形激活的速度慢于字音激活与音形结合的速度，读者会更多频次地回视异音形似别字，以确认其汉字正确形状。

结合后期眼动指标而言，结合后期眼动指标而言，注视次数的多少可以反应阅读的加工负荷。总注视时间与回视路径时间代表着汉语学习者在认知后期阶段的心理图式。对于别字所在词语兴趣区而言，无论是加工负荷抑或是后期加工过程中，汉语阅读者对字形激活的速度都显著小于字音激活与音形结合作用激活。

5.3.3 别字类型对整句识别的影响

1、别字类型对平均注视时间指标的影响

由于别字类型差异的主效应不显著，因此可以认为不同语言背景在不同语言水平时，阅读含有不同别字的整句时的平均注视时间没有显著差异，代表着虽然阅读者对别字或别字词语的字音、音形结合、字形激活的速度有所差异，但在整句中却不影响整体识别。

2、别字类型对总阅读时间指标的影响

由于别字类型差异的主效应不显著，因此可以认为不同语言背景在不同语言水平时，阅读含有不同别字的整句时的总阅读时间没有显著差异，代表着虽然阅读者对别字或别字词语的字音、音形结合、字形激活的速度有所差异，但在整句中却不影响整体识别。

3、别字类型对总注视次数指标的影响

由于别字类型差异的主效应不显著，因此可以认为不同语言背景在不同语言水平时，阅读含有不同别字的整句时的总注视次数没有显著差异，代表着虽然阅读者对别字或别字词语的字音、音形结合、字形激活的速度有所差异，但在整句中却不影响整体识别。

综合整句的眼动指标而言，别字类型对阅读者的整句识别都没有起到影响。因此，我们得出结论：汉语阅读者在阅读含有不同类型别字的整句时，不会因为别字的缘由而增加其平均注视次数以及总阅读时间，因此更加证明阅读者对别字具有检测与复原效应。

5.4 数据讨论对联结主义模型的建构

5.4.1 双通道模型的不足

双通道模型中的“词典通路”与“非词典通路”之间哪一条通路更快决定了谁提取词义。在上文的资料分析之中，我们以别字所在单字兴趣区为例，汉语阅读者在早期认知过程中，别字类型差异主效应并不显著，无论语言背景以及语言水平的汉语阅读者对别字的首次注视时间没有显著差异。

但对于被试者而言，我们并未能保证其对实验材料中的所有别字词汇都掌握完全，因此被试者到底运用哪一种通路进行提取词义也不得而知。除此以外，若假设被试者全部依照“非词典通路”进行提取语义，通过亚词汇水平的形音对照原则了解词义特征，那么资料分析中所出现的被试者在识别过程中的早期、晚期过程中，字音、音形结合以及字形激活却在不同阶段充当了不一样的角色。这也是双通道模型所难以解答的。

5.4.2 联结主义模型的建构

通过第五章前半部分中的资料讨论，我们总结出如下结论：汉语学习者在早期过程中对别字的注视中，可能有多个注视点，因此我们选取凝视时间作为其加工早期代表的最佳指标。那么，汉字圈学习者无论初级水平还是高级水平，对字音、音形结合以及字形激活都保持着近似的同等地位，无一占主导地位。非汉字圈初级水平学习者的早期认知模型中，占主导地位的依次为字形、字音与音形结合，非汉字圈高级水平学习者的早期认知模型中，占主导地位的依次为字形、音形结合与字音，且前两者处于同等位置。且非汉字圈高级水平学习者的字形、音形结合的识别速度可以与汉字圈高级水平学习者匹敌。

汉字圈对于别字的注视次数的认知结构中，即加工负荷按照由小到大的次序：字音、音形结合、字形，其中字音与音形结合的负荷处于同等位置，且随着语言水平的提高，各因素的识别速度也随之相应提高。非汉字圈对于别字的注视次数的认知结构中，即加工负荷按照由小到大的次序：字音、字形、音形结合，其中字形与音形结合的负荷处于同等位置。且认知速度并不随着语言水平的提高而有显著的提高。

汉字圈对别字的晚期认知过程会依据如下的占主导地位的次序：字音、音形结合、字形，且随着语言水平的提高，识别速度会随之提高。非汉字圈对别字的晚期认知过程会呈现出如下的占主导地位的次序：字音、音形结合、字形。非汉字圈对别字的晚期认知过程中，字音、字形和音形结合的地位较为平等，无一占主导地位。且随着语言水平的提高，其识别速度也随之提高。除此以外，非汉字圈学习者对字形的识别速度与汉字圈学习者接近，说明在识别后期过程中，汉语学习者对字形的认知基本可以稳定在一个程度。

表 4 汉字圈与非汉字圈学习者对别字中字音、音形结合、字形激活速度图示

语言背景	语言水平	识别阶段	字音	音形结合	字形
汉字圈	初级水平	早期	++	++	++
		晚期	+++	+++	++
		加工负荷	+++	+++	++
	高级水平	早期	+++	++	++
		晚期	++++	++++	+++
		加工负荷	+++	+++	++
非汉字圈	初级水平	早期	++	+	++
		晚期	++	++	++
		加工负荷	+++	++	++
	高级水平	早期	++	+++	+++
		晚期	+++	+++	+++
		加工负荷	+++	++	++

注：+表示识别的速度，数量越多，表示识别速度越快；其中加工负荷越小，+越多

根据联结主义模型，不同语言背景、不同语言水平的学习者在阅读不同类型别字时，正是由于各自经验的不同，对正字层、音韵层、词义层的联结具有不同之处。

对于汉字圈初级水平学习者而言，在正确的词语环境下，若词语中单字的语音或字形被改变，但其模型内部剩余的正字层或音韵层未被改变，则阅读者在早期认知结构中，三层之间的关系较为稳固，正字层与音韵层的神经元的表征速度并无显著差异。但阅读者在后期认知结构中，音韵层相较于正字层，其与语义层的联结则更为紧密，因此可以解释音韵语义的强式联结能够促进相关音义对应，如同音异形别字的晚期识别速度。

对汉字圈高级水平学习者而言，在正确的词语环境下，若词语中单字的语音或字形被改变，但其模型内部剩余的正字层或音韵层未被改变，则阅读者在早期认知结构中，正字层相较于音韵层，其与语义层之间的联结更为紧密，并呈现出正字—语义神经元联结强于音韵—语音神经元联结，并单条联结强于正字、音韵双条联结速度。但阅读者在后期认知结构中，音韵层相较于正字层，其与语义层的联结则更为紧密，因此可以解释音韵语义的强式联结能够促进相关音义对应，如同音异形别字的晚期识别速度。

对于非汉字圈初级学习者而言，在正确的词语环境下，若词语中的单字的语音或字形被改变，但其模型内部剩余的正字层或音韵层未被改变，则阅读者在早期认知结构模型中，正字层、音韵层与语义层之间的联结速度在时间上较为相近，难以区分快慢，但若语音相同且字形相近反而降低加工速度，说明在联结主义模型中，两类神经元的单独联结会更利于加工，若两条线条复合加工，反而会影响到不同网络层的加工速度，影响与语音之间的理解。在阅读者的晚期认知模型之中，三层之间的结构关系却变得较为稳固，正字层与音韵层的神经元的表征速度并无显著差异。

对于非汉字圈高级水平学习者而言，在正确的词语环境下，若词语中的单字的

语音或字形被改变，但其模型内部剩余的正字层或音韵层未被改变，则阅读者在早期认知结构模型中，正字层相较于音韵层，其与语义之间的联结更为紧密，并呈现为强于音韵—语音神经元联结，并且该单条联结与正字、音韵双条联结之间无显著加工速度上的差异。因此，可以解释为正字语义的强式联结能够促进正字、音韵之间双向的识别。在阅读者的晚期认知模型之中，三层之间的结构关系却变得较为稳固，正字层与音韵层的神经元的表征速度并无显著差异。

对于母语者而言，正是由于三个层次之间的稳固联结，以及词条相关神经元的快速激活，因此字音、字形、音形结合与词义之间的早期认知速度与晚期认知速度没有显著差异，表现出成熟的语言学习者的内部联结模型。

以上联结主义模型的建构中，我们可以发现不同语言背景、不同语言水平在早期认知和晚期认知过程中的内部神经元联结方式不同。因此在内部正字层、音韵层、语义层之间的关系具有变化性，随着阅读者对别字认知的经验程度而改变。

同时，第二语言习得理论中的迁移理论对以上结论也可以做出辅助解释。来自汉字圈语言背景的学习者在晚期识别过程中都呈现出音韵—语义联结更为紧密的情况，而来自非汉字圈语言背景的高级水平学习者在晚期识别过程中却呈现出正字—音韵联结更为紧密的情况。汉字圈背景语言学习者由于本国语言文字中具有汉字或于教育阶段接触过汉字，因此对汉字正字层面更为熟悉，因此会花费更多时间查看字形的准确度，增加了注视时间与注视次数，从而表现出音韵—语义之间的识别快速与紧密。非汉字圈语言学习者则由于本国语言文字的缘由，语音编码起着更为重要的作用，因此会花费更多的时间去检测音韵的准确性，对字形的精确性则不那么关注，从而表现出正字—语义之间的识别快速与紧密。

5.5 教学建议

针对以上汉语学习者在认知过程中对字形、字音以及音形结合的联结作用，虽然都随着语言水平的提高，认知速度也随之提高。但汉字圈与非汉字圈高级水平学习者仍然与母语者之间有着些许差异，母语者对三者的认知速度都保持平均水平，无显著差异。这表明母语者在音、形、义的联结中，处于完全成熟的联结状态。因此，在汉语作为第二语言教学之中，我们需要针对不同语言水平的学生，甚至在国外教学环境中，对不同语言背景的学生的汉字阅读教学提出对症下药的教学策略。

针对汉字圈学习者而言，由于语言背景的影响，其对字形有更多的依赖和识别意识。对于汉语阅读教学而言，教师应该更多加强对“字形”的辨认教学，促使学习者提高对字形的记忆准确度以及记忆深度。由于后期识别过程中，汉字圈学习者更加依靠与依赖字音与语义的联结作用。对于汉语阅读教学而言，教师也应该更注重语音学习的精细化，在日韩等学生的学习过程中，注重对相似音的教学，让汉语学习者保持准备发音的良好习惯。

针对非汉字圈学习者而言，则更需要根据语言水平进行分类教学安排。在汉语

初级水平阶段，由于学习者刚接触汉语，并且由于汉语作为表意文字的特点，其更多注重字形与语义的联结。因此，教师应该相较于汉字圈学习者，需要花更多精力帮助非汉字圈学习者对字形有更准确认知。而在汉语高级水平阶段，在早期认知阶段中字音起到的干扰作用最大，以及在晚期认知阶段中，音形结合起到的干扰作用最大。因此，教师应该强调字音对汉字认知起到的辅助作用，通过相近音的辨别学习，借助语言背景的积极作用，提升语音解码能力。

同时，无论对哪种语言背景的学习者而言，音形结合在汉字认知中的作用都没有起到最主导的作用。因此，教师可以在教学当中，更多地将语音与字形结合在一起讲解，更有效地表达汉字作为表意文字的特点，

最后，通过别字眼动实验不光证明字形、字音在第二语言学习者认知的作用，也提醒教师需要在教学中提示学习者在汉语阅读或汉字记忆时，不可由于汉字的熟悉度或掌握程度而忽略对其加工的精细程度，可能较为自信掌握的词语反而会导致错误。

6. 结论

本文为探究汉语作为第二语言阅读者在上下文语境中，阅读别字时是否会发生别字检测与复原效应，且针对同音异形别字、同音形似别字与异音形似别字的阅读心理过程，了解形、音、义三者之间的联结程度，并建立相关模型。通过设计眼动实验，并分析早期、晚期眼动指标后，本文得出以下 5 个结论：

1、别字所在整句与无别字整句之间各项眼动指标都无显著差异，因此认为别字可以被学习者顺畅阅读，即别字可被自动修复，完成词语及语句的理解。

2、汉字圈学习者与非汉字圈学习者无论语言水平，在别字的早期识别过程中，都呈现出字形与语义的强联结作用，但非汉字圈的汉字复原与检测效应更弱于汉字圈学习者。

3、在汉语阅读文本加工难度上，汉字圈学习者更优于加工异音形似别字，即形码与语义之间的联结更强；而非汉字圈学习者则更优于加工同音异形别字，即音码与语义之间的联结更强。

4、在别字认知过程的后期阶段，汉字圈学习者更依赖于字音与语义的转化，非汉字圈学习者则对音、形、音形结合的解码速度一致，表示非汉字圈更多注重于早期字形的解码作用。

5、母语者对音、形、义的识别模型中，字音、字形与音形结合的解码都是相同速度的，无一者处于主导地位。因此其认知结构为成熟语言者对汉语阅读的稳定结构。

因此本文通过实验得出的结论与第一部分所提出三个假设有不符合之处。假设

1 中前半部分“在词义上层阶段，即使下层的语音或字形改变，也会受到自上而下的语境的影响，自动修复别字，不影响阅读进程”成立，但后半部分“这种效应可以发生在语言的早期阶段，并随着语言水平提高，阅读者将会从依靠字音转为依赖字形”在实验分析下被否定，由于不同语言背景对字音、字形与语义的联结关系紧密程度不一致，无法作出统一性结论。

假设 2 中“非汉字文化圈的学生在正确词语语境下面对同音异形别字或同音形似别字时，会比汉字文化圈学生表现出更强的汉字复原和汉字检测。汉字文化圈学生在面对异音形似别字时会比非汉字文化圈学生表现出更强的汉字复原和检测效应。”观点并不成立，实验分析得出结论：汉字文化圈学生与非汉字文化圈的学生在正确词语语境下对异音形似别字时，都表现出汉字复原检测效应，汉字圈学习者稍强一些。

假设 3 成立，即：联结主义模型下正字层、音韵层与词义层之间的神经沟通可能并不同于普通的三层等距结构，而是呈现以词义为中心层的正字层与音韵层的松散关系，并且不同语言背景的学习者在不同语言水平下，且在早、晚期认知阶段中的联结模型也有不同。

并依据结论，本文对汉语作为第二语言的课堂教学提出了相应意见，分别针对字形、语音、音形结合以及别字认知在汉语阅读教学中的作用，提出了四点建议。希望教师可在教学环节中，增加字形、相近音辨认环节，提高汉字形音理解结合度以及提高学生对别字的重视程度。

参考文献

Balota, D. A., Pollatsek, A., & Rayner, K. (1985). The interaction of contextual constraints and parafoveal visual information in reading. *Cognitive psychology*, *17*(3), 364-390.

Binder, K. S., Pollatsek, A., & Rayner, K. (1999). Extraction of information to the left of the fixated word in reading. *Journal of Experimental Psychology: Human Perception and Performance*, *25*(4), 1162-1172.

Chen, Y. P., Allport, D. A., & Marshall, J. C. (1996). What are the functional orthographic units in Chinese word recognition: The stroke or the stroke pattern? *The Quarterly Journal of Experimental Psychology Section A*, *49*(4), 1024-1043.

Chi, H., Yan, G. L., Xu, X. L., Xia, Y., Cui, L., & Bai, X. J. (2014). The effect of phonetic radicals on identification of Chinese phonograms: Evidence from eye Movement. Acta Psychologica Sinica, *46*(9), 1242-1260. [迟慧, 闫国利, 许晓露, 夏萤, 崔磊, & 白学军. (2014). 声旁语音信息对形声字加工的影响——来自眼动研究的证据. *心理学报*, *46*(9), 1242-1260.]

Feng, G., Miller, K., Shu, H., & Zhang, H. (2001). Rowed to recovery: The use of phonological and orthographic information in reading Chinese and English. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *27*(4), 1079-1100.

Gao, L. Q., & Meng, L. (2000). Recognition of Chinese characters by foreign learners: The role of the phonetic and orthographic codes. Chinese Teaching in the World, 4, 67-76. [高立群, & 孟凌. (2000). 外国留学生汉语阅读中音, 形信息对汉字辨认的影响. *世界汉语教学*, 4, 67-76.]

Goh, Y. S. (1990). The relationship between learner errors in Chinese character acquisition and learning strategies. In Beijing Language Institute (Ed.), *Proceedings of the 3rd international conference on Chinese language teaching* (pp. 156-161). Beijing: Beijing Language Institute Press. [吴英成. (1990). 学生汉字偏误及其学习策略的关系. 北京语言学院(编), *第三届国际汉语教学讨论会论文选*(pp. 156-161). 北京: 北京语言学院出版社.]

Healy, A. F. (1976). Detection errors on the word the: Evidence for reading units larger than letters. *Journal of Experimental Psychology: Human Perception and Performance*, *2*(2), 235-242.

Jiang, X., & Liu, Y. (2004). A study of character writing errors by foreign learner using alphabetic writing. *Chinese Teaching in the World, 67*(1), 60-70. [江新, &柳燕梅. (2004). 拼音文字背景的外国学生汉字书写错误研究. *世界汉语教学*, *67*(1), 60-70.]

Liu, P. P., Li, W. J., Han, B. X., & Li, X. S. (2014). Effects of anomalous characters and small stroke omissions on eye movements during the reading of Chinese sentences. Paper presented at The Fourth Mental Health Conference, Wuxi, China. [刘萍萍, 李卫君, 韩布新, & 李兴珊. (2014). 书写错误信息对汉语阅读眼动控制的影响. 第四届心理健康学术年会, 无锡, 中国.]

Lu, X. H. (2007). A survey on the development of foreign students' use of phonological code and orthographic code of Chinese character in reading comprehension. *Journal of Yunnan Normal University (Teaching and Research on Chinese as a Foreign Language Edition), 5*(1), 34-38. [吕欣航. (2007). 留学生在汉语阅读中利用字形和语音信息的研究. *云南师范大学学报 (对外汉语教学与研究版)*, *5*(1), 34-38.]

Ma, M. Y., & Chuang, H. C. (2015). A Legibility Study of Chinese Character Complicacy and Eye Movement Data. *Perceptual and motor skills*, *120*(1), 232-246.

Miellet, S., & Sparrow, L. (2004). Phonological codes are assembled before word fixation: Evidence from boundary paradigm in sentence reading. *Brain and language*, *90*(1-3), 299-310.

Newell, A., & Simon, H. A. (1976). Computer science as empirical inquiry: Symbols and search. *Communications of the ACM, 19*(3), 113-126.

Perfetti, C. A. (1985). *Reading ability*. New York: Oxford University Press.

Pollatsek, A., Lesch, M., Morris, R. K., & Rayner, K. (1992). Phonological codes are used in integrating information across saccades in word identification and reading. *Journal of Experimental Psychology: Human Perception and Performance*, *18*(1), 148-162.

Reicher, G. M. (1969). Perceptual recognition as a function of meaningfulness of stimulus material. *Journal of experimental psychology*, *81*(2), 275-280.

Shi, J. W. (1998). Research on the acquisition order of 22 sentence types in modern Chinese by foreign students. Chinese Teaching in the World, (4), 77-98. [施家炜. (1998). 外国留学生 22 类现代汉语句式的习得顺序研究. *世界汉语教学*, (4),

77-98.]
Song, H., Zhang, H. C., & Shu, H. (1995). The developmental shift of the role of graphic code and phonetic code in Chinese Reading. *Acta Psychologica Sinica*, *27*(2), 139-144. [宋华, 张厚粲, & 舒华. (1995). 在中文阅读中字音, 字形的作用及其发展转换. *心理学报*, *27*(2), 139-144.]
Wang, J. (2019). The difficulty level of Chinese characters in acquisition by foreigners: A study based on data analysis. *The Study of Chinese Characters,* (1), 217-227. [王骏. (2019). 外国人汉字习得的难度等级——一项基于数据库的研究. *中国文字研究*, (1), 217-227.]
Yang, J., Wang, S., Tong, X., & Rayner, K. (2012). Semantic and plausibility effects on preview benefit during eye fixations in Chinese reading. *Reading and Writing*, *25*(5), 1031-1052.
Yang, J. F., & Shu, H. (2008). A connectionist model of Chinese characters reading. *Acta Psychologica Sinica, 40*(5), 516-522. [杨剑锋, & 舒华. (2008). 汉字阅读的联结主义模型. *心理学报, 40*(5), 516-522.]
Zhang, J. Q. (2007). Characteristics of the role of sound and grapheme of the Chinese characters in reading for foreign students with different mother languages. *Journal of South China Normal University (Social Sciences Edition)*, (2), 119-123. [张金桥. (2007). 不同母语背景留学生汉语阅读中字音, 字形作用的特点. *华南师范大学学报: 社会科学版*, (2), 119-123.]
Zhang, Y. R. (2009). *An eye movement research on the phonetic and glyph activation effect in Chinese vocabulary recognition* (Unpublished master's thesis). Shaanxi Normal University, Xi'an, China. [张益荣. (2009). *汉语词汇识别中语音, 字形激活效应的眼动研究* (未出版硕士论文). 陕西师范大学, 西安, 中国.)
Zhu, M. H. (2016). A comparative study of character writing acquisition by foreign students and elementary students in China: A case study of beginning level foreign students and first-grade elementary students in China (Unpublished master's thesis). Guizhou University, Guiyang, China. [朱明恒. (2016). *留学生与中国小学生汉字书写习得比较分析——以初学汉语的留学生和中国一年级小学生为研究对象* (未出版硕士论文), 贵州大学, 贵阳, 中国.]

附录 1 眼动实验材料

Example:　欧文在上海交通大学大约学习了两年的汉语，并且非常努力。老师们都很喜欢他。

ōuwénshìyígènǔ lì xuéxíhànyǔdexuéshēng

题目：　欧 文 是一个努力 学 习 汉 语的 学　生　。

一、无激活对照组

1、每个人的家里都有家具，所以对于家具我们并不陌生。现在让我们去看看未来的家具吧。

wǒmenduìjiājùhěnmòshēng

题目：　我 们 对家具很 陌　生　。　　答案：错误

2、在我还记得第一天来到学校时的情景，当时我一句汉语也不会，老师就耐心地帮助我。

wǒgānglái xuéxiàojiùhuìshuōhànyǔ

题目：　我 刚 来学 校 就会 说 汉 语。　　答案：错误

3、谈话要有礼貌。说话要自然。说话时可做些手势，但动作不要太大，不要用手指指人。

shuōhuàshíshǒushìdòngzuòbùnéngtàidà

题目：　说 话时 手 势 动 作不 能 太大。　　答案：正确

4、我印象最深的同桌是小红。她有一双葡萄那样的大眼睛，爱帮助别人是她的优点。

xiǎohóngxǐhuanbāngzhùbiérén

题目：　小　红 喜 欢　帮 助 别 人。　　答案：正确

5、我会做很多菜。有一次，我在学生文化节上烤了蛋糕和小甜饼等，很受大家的欢迎。

wǒhuìzuòdàngāohétángguǒ

题目：　我会 做 蛋 糕和 糖　果。　　答案：错误

6、我特别喜欢和同学一起住宿舍的每一天。住宿舍的一个好处是能够认识来自各地的朋友。

wǒ tè bié xǐhuansùshèshēnghuó

题目：　我特别喜 欢 宿舍　生　活。　　答案：正确

7、王先生是一个没有太多爱好的人，每天除了看书就是看电视，日子虽然平淡但他自己很快乐。

wángxiānshēngměitiāndōuméiyǒushìqíngzuò　suǒyǐhěnwúliáo

题目：　王　先　生　每 天 都 没 有 事 情　做，所以很 无 聊。　答案：错误

8、宿舍生活是我校园生活中最难忘的一部分，与舍友在一起的日子给了我许多美好的回忆。

wǒ xǐ huan hé shěyǒu zài yì qǐ de sù shè shēng huó

题目：　我 喜 欢 和 舍 友 在 一起的宿 舍　生　活 。　答案：正确

9、我最喜欢的动物是狗，狗是人类的好朋友，有的狗非常喜欢和主人一起散步、游泳、爬山。

gǒu néng hé zhǔ rén yì qǐ chī fàn　sàn bù　yóu yǒng

题目：　狗　能　和 主 人 一起吃 饭 、散 步、 游　泳　。　答案：错误

10、王先生是上海一家电脑公司的经理。他工作很忙，常常要到别的城市出差。

wáng xiān shēng gōng zuò yì diǎn yě bù máng

题目：　王　先　生　工　作 一 点 也不　忙　。　答案：错误

二、字音激活对照组

1、两位热爱中国文化的美国老师用中国字非常用心地**部**置了她们的教室。

liǎng wèi měi guó lǎo shī de jiào shì lǐ yǒu zhōng guó zì

题目：　两　位 美 国 老 师的 教 室里 有　中　国 字。　答案：正确

2、小红还和我有个约**订**，我教她英文，她教我中文，我们俩要互相留作业。

wǒ hé xiǎo hóng hù xiāng bāng zhù xué xí wài yǔ

题目：　我 和 小　红　互　相　帮　助 学 习 外 语。　答案：正确

3、学好中文就可以**冲**分欣赏中国文化，这是我自己在学习中文两年的体会。

wǒ xué zhōng wén liǎng nián le

题目：　我 学　中　文　两　年 了。　答案：正确

4、我、小白和李红三个人约好星期天早上九点在学校门口见面，然后一起去动物园看**雄**猫。

wǒ men sān gè rén xīng qī liù qù dòng wù yuán wán

题目：　我 们 三 个 人 星 期六去 动　物　园　玩 。　答案：错误

5、春天是个很美的**记**节，希望每个人都能好好利用春天，快乐地度过这可爱的**记**节。

měi gè rén dōu yīng gāi xǐ huan chūn tiān　yīn wéi tā hěn kě ài

题目：　每 个 人 都　应　该 喜　欢　春　天 ，因 为 它 很 可爱。　答案：错误

6、我住在上海，我家在一栋高高的六层楼房里，外面可以眺望到东方**名**珠。

wǒ de jiā zài shàng hǎi yī dòng wǔ céng lóu fáng lǐ

题目：　我 的家 在　上　海 一　栋　五　层　楼　房　里。　答案：错误

7、我们对使用**明**片有一个建议：不要随便发明片。在多人一起时，交换**明**片应在私下进行　。

míngpiànbùnéngsuíbiàn fā　yǒudeshíhòuxūyào sī xià fā

题目：　明 片 不 能 随 便 发，有 的时 候 需 要 私 下 发。 答案：正确

8、爸爸和妈妈的卧室很大，里面有一张大床还有大桌子，桌子上有妈妈的香水和话妆品。（未在实验分析中分析该句）

wòshì lǐ yǒuxiǎochuánghédàzhuō zǐ

题目：　卧 室里 有 小　床　和大 桌 子。 答案：错误

9、我家的客厅很大并且很漂亮，里面有着很多花和植物。并且还有一个养着热带鱼的鱼刚。（未在实验分析中分析该句）

wǒjiākètīng lǐ yǒuhuā　zhíwùhé yī zhīgǒu

题目：　我 家客 厅 里 有 花 、植 物和一 只 狗 。　答案：错误

10、这个周末我采访了很多有名的人，他们都非常友善并且懂很多的知识，我很辛赏他们。

wǒcǎifǎngderéndōuhěnyǒushànbìngqiědǒnghěnduō

题目：　我 采 访 的人 都 很 友 善 并 且 懂 很 多 。 答案：正确

三、字音、字形激活对照组

1、那天晚上他们精采的表演引来了其他班的小朋友的观看和一片热烈的掌声。

tā mendebiǎoyǎnhěnhǎo　xiǎopéngyǒuhěn xǐ huankàn

题目：　他 们 的 表 演 很 好 ， 小 朋 友 很 喜 欢 看 。　答案：正确

2、星期二早晨，我一走进教室，就看到好多五颜六色的气球绑在我的倚子上。

jiàoshì lǐ yǒuhěnduōbùtóngyán sède qì qiú

题目：　教 室里 有 很 多 不 同 颜 色的气 球 。　答案：正确

3、这电视机和以前用的外貌虽然相差不大，可工能却是大不相同啊！

diànshì jī hé yǐ qiándewánquán yí yàng

题目：　电 视机和以 前 的 完　全 一 样 。　答案：错误

4、才五分钟，天气就从暖和的情天变成了大雨，大自然的变化可真是快啊！

zhèwǔfēnzhōngdetiān qì biànhuàhěnkuài

题目：　这 五 分　钟　的 天 气 变 化 很 快 。　答案：正确

5、对于中国人来说，面子非常重要。最不好的事就是失去了面子，所以要住意小心批评。

zhōngguórénzuìhàipàshīqùmiànzi

题目：　中　国　人 最 害 怕 失 去　面　子。　　答案：正确

6、妈妈很辛苦，每天早上要从**交**区那么远的地方把我送到学校，让我不迟到。

wǒměitiānzì jǐ cóngjiādàoxuéxiàoqùshàngxué

题目：　我 每　天 自己 从　家 到　学　校 去　上　学。　　答案：错误

7、爸爸和妈妈的工作很忙，没有时间照顾我，所以我**胫**常去我的邻居家找我的朋友玩。　（未在实验分析中分析该句）

bàbamāmābùzàijiā　suǒyǐwǒqùzhǎopéngyǒuwán

题目：　爸爸妈 妈不在家，所 以我去 找　朋　友　玩 。　答案：正确

8、**蓝**球是流行全世界的一项体育运动，我也很喜欢，所以经常在家附近的体育场打球。　（未在实验分析中分析该句）

wǒxǐhuanzài tǐ yùchǎng tī zúqiú

题目：　我喜　欢　在体育　场　踢足球。　　答案：错误

9、我明白了一个道**里**：一个人得不到他想要的东西，就说东西不好，这样的想法是很可笑的。

rúguǒyígèréndédàotāxiǎngyàodedōngxī　jiùshuōdōngxībùhǎo

题目：　如 果 一个 人 得 到 他　想　要 的　东　西，就　说　东　西不 好 。　答案：错误

10、我的妹妹特别喜欢踢足球，她爱穿白色的衣服，并且尤其喜欢吃蛋糕和**宁**檬。

wǒdemèimèixǐhuanchuānbáisè yī fu　bìngqiěxǐhuanchīdàngāo

题目：　我的 妹　妹 喜　欢　穿　白 色衣服，　并　且喜　欢　吃　蛋　糕。　答案：正确

四、字形激活对照组

1、星期**曰**的晚上，小明从纽约给我打电话，说他今天下午四点三刻到上海，让我去接他。

xiǎomíngyàocóngniǔyuēhuíláishànghǎi

题目：　小　明　要　从　纽 约 回 来　上　海。　　答案：错误

2、我最近喜欢在家里自己做饭吃，所以每天下完课，我就去附近的超**市**买蔬菜和肉回家。

wǒyìzhídōuhěnxǐhuanzì jǐ zuòfànchī

题目：　我一直 都 很 喜　欢 自己 做 饭 吃。　答案：错误

3、我最好的朋友是欧文，他有蓝色的眼睛，棕色的头发，胖乎乎的脸，但他的身**休**一点儿也不胖。

ōuwénshì yí gèquánshēndōufēichángshòudenánhái

题目：　欧 文 是一个 全　身 都 非　常　瘦 的 男 孩。　答案：错误

4、我们班上来了一位新同学，我汪意她很久了，我想她一定知道我喜欢她。

wǒ xǐ huanwǒmenbānshàngde yī wèixīntóngxué

题目：　我 喜 欢 我 们 班　上　的一 位 新 同 学 。　答案：正确

5、我的房问是我最喜欢的地方，喜欢它的摆设，喜欢它的温馨，还喜欢它的宽大。

wǒdefángjiānbúshìfēichángdà　dànshìhěnwēnxīn

题目：　我 的 房　间 不 是 非　常　大，但 是 很　温　馨 。　答案：错误

6、因为我马上要去美国旅行，所以我去银行把人民币换成了美元，大约换了 5000 元。

wǒwèi le lǚ yóuhuàn le　yuándeměiyuán

题目：　我 为 了旅 游　换　了5000 元 的 美　元 。　答案：正确

7、和考朋友见面，我们一起吃饭，然后回房间喝咖啡，谈话，这使我们非常高兴。

wǒhépéngyǒu yì qǐ shǐwǒmenhěnkāixīn

题目：　我 和 朋　友 一起 使 我 们 很 开 心 。　答案：正确

8、上周末我们全家去钓鱼了，我等待了很长时间，才有一条又大又肥的鱼上钧。

（未在实验分析中分析该句）

shàngzhōumòwǒděng le hěnjiǔ　quèméiyǒudiàodàoyú

题目：　上　周　末 我　等　了 很 久，却 没 有　钓　到 鱼。　答案：错误

9、哥哥的爱好与众不同，既不是踢足球、打篮球，也不是看书，而是喜欢研究那枯躁的数学题。

gēgēhéwǒ yí yàng　xǐ huanzuòshùxué tí

题目：　哥哥和 我 一 样 ，喜 欢　做 数 学 题。　答案：错误

10、小时候我是个很文静而害羞的小女孩，可长大以后不少人却看不出来我快乐活泼的天性。

（未在实验分析中分析本句）

xiǎoshíhòuwǒjiùshìgèfēichángkuài lè dexiǎonǚhái

题目：　小 时 候 我就 是 个非　常　快 乐的 小 女 孩。　答案：错误

附录 2 测试识字量问卷

Questionnaire

xìngmíng
1、姓 名 （Name）：_____

guó jí
2、国籍（Nationality）：_____

niánlíng
3、年 龄（Age）(If you don't want to reveal any personal details，just skip it):_____

hànyǔ shuǐpíng
4、汉语水 平（Level）

chūsān　chū sì　gāo yī　gāo èr　gāosān　běn èr　běnsān　běn sì
A、初三　B、初四　C、高一　D、高二　E、高三　F、本二　G、本三　H、本四

Literacy Test

Directions: Choose (circle) the only accurate reading for each character/word, or honestly choose "I don't know" if you are not able to recognize the character. This test has nothing to do with your academic grade, but good performance will be rewarded in other forms later on.

Part 1 Chinese Characters

1	分	A. **fēn** as in **fēn kāi**	B. **bàn** as in **dǎ bàn**
		C. **dāo** as in **yì bǎ dāo**	D. I don't know
2	心	A. **shuǐ** as in **hē shuǐ**	B. **huǒ** as in **huǒ chē**
		C. **xīn** as in **kāi xīn**	D. I don't know
3	使	A. **biàn** as in **fāng biàn**	B. **shǐ** as in **dà shǐ guǎn**
		C. **tíng** as in **tíng chē**	D. I don't know
4	品	A. **pǐn** as in **shí pǐn**	B. **bàn** as in **yí bàn**
		C. **píng** as in **píng shí**	D. I don't know
5	被	A. **pí** as in **pí jiá kè**	B. **kù** as in **kù zi**
		C. **bèi** as in **bèi zi**	D. I don't know
6	眼	A. **yǎn** as in **yǎn jīng**	B. **gēn** as in **gēn tā yì qǐ**
		C. **hěn** as in **hěn hǎo**	D. I don't know
7	每	A. **měi** as in **měi tiān**	B. **hǎi** as in **hǎi biān**
		C. **huǐ** as in **hòu huǐ**	D. I don't know
8	车	A. **lián** as in **lián ...yě ...**	B. **chē** as in **qì chē**
		C. **dōng** as in **dōng biān**	D. I don't know
9	复	A. **xià** as in **xià tiān**	B. **fù** as in **fù xí**
		C. **hòu** as in **hòu de yī fu**	D. I don't know
10	斯	A. **qī** as in **xué qī**	B. **sī** as in **sī wén**
		C. **qí** as in **qí zhōng**	D. I don't know
11	某	A. **mǒu** as in **mǒu rén**	B. **méi** as in **shāo méi**
		C. **dāi** as in **dāi zài jiā lǐ**	D. I don't know
12	费	A. **hè** as in **zhù hè**	B. **fèi** as in **làng fèi**
		C. **zī** as in **gōng zī**	D. I don't know

13	独	A. **dú** as in **dú lì**	B. **gǒu** as in **yì tiáo gǒu**
		C. **hóng** as in **cǎi hóng**	D. I don't know
14	云	A. **yuǎn** as in **bú tài yuǎn**	B. **yùn** as in **yùn dòng**
		C. **yún** as in **tiān shàng de yún**	D. I don't know
15	策	A. **cè** as in **zhèng cè**	B. **dì** as in **dì yī míng**
		C. **cì** as in **fěng cì**	D. I don't know
16	移	A. **yí** as in **yí dòng**	B. **chǐ** as in **shē chǐ**
		C. **hé** as in **hé píng**	D. I don't know
17	爷	A. **bà** as in **bà ba**	B. **yé** as in **yé ye**
		C. **fǔ** as in **fǔ tou**	D. I don't know
18	祖	A. **zǔ** as in **zǔ zhī**	B. **zǔ** as in **zǔ guó**
		C. **zū** as in **fáng zū**	D. I don't know
19	退	A. **tuì** as in **hòu tuì**	B. **tuǐ** as in **yì tiáo tuǐ**
		C. **gēn** as in **shù gēn**	D. I don't know
20	典	A. **diǎn** as in **cí diǎn**	B. **tái** as in **wǔ tái**
		C. **xìng** as in **gāo xìng**	D. I don't know
21	秋	A. **chóu** as in **fā chóu**	B. **huò** as in **huò wù**
		C. **qiū** as in **qiū tiān**	D. I don't know
22	钢	A. **gāng** as in **gāng gāng**	B. **gāng** as in **gāng tiě**
		C. **fēng** as in **guā fēng**	D. I don't know
23	载	A. **dài** as in **dài màozi**	B. **zǎi** as in **xià zǎi**
		C. **cái** as in **cái feng**	D. I don't know
24	泥	A. **ne**-a modal particle for question	B. **xǐ** as in **xǐ yīfu**
		C. **ní** as in **ní tǔ**	D. I don't know
25	仪	A. **yí** as in **yí biǎo**	B. **yì** as in **shāng yì**
		C. **yì** as in **yì qì**	D. I don't know
26	炮	A. **pào** as in **pào chá**	B. **pào** as in **biān pào**
		C. **bāo** as in **bāo zi**	D. I don't know
27	怒	A. **nǔ** as in **nǔ lì**	B. **nù** as in **fèn nù**
		C. **xiǎng** as in **xiǎng niàn**	D. I don't know
28	梁	A. **liàng** as in **yuán liàng**	B. **liáng** as in **liáng shuǎng**
		C. **liáng** as in **dòng liáng**	D. I don't know
29	嘛	A. **má** as in **má fan**	B. **xiū** as in **xiū xi**
		C. **ma**-a modal particle	D. I don't know
30	昨	A. **zuó** as in **zuó tiān**	B. **zěn** as in **zěn me**
		C. **zuò** as in **gōng zuò**	D. I don't know

Part 2 Vocabulary

1	给	A. raise	B. receive
		C. give	D. I don't know
2	当然	A. of course	B. afterwards
		C. however	D. I don't know
3	先	A. birth	B. first
		C. choose	D. I don't know
4	弹钢琴	A. play violin	B. play drum
		C. play piano	D. I don't know
5	困难	A. difficulty	B. risk
		C. poverty	D. I don't know
6	推迟	A. inform	B. delay
		C. push	D. I don't know
7	至少	A. at least	B. lack
		C. arrive	D. I don't know

8	措施	A. measure; approach	B. result; consequence	C. mistake; error	D. I don't know
9	高速公路	A. highway	B. street corner	C. crossroads	D. I don't know
10	角色	A. angle	B. character; role	C. surface color	D. I don't know
11	面临	A. to reveal; to uncover	B. to interview	C. to face; to confront	D. I don't know
12	荣幸	A. honorable	B. unfortunate	C. lucky	D. I don't know
13	位置	A. terminal	B. position	C. center	D. I don't know
14	愿望	A. wish	B. decision	C. promise	D. I don't know
15	安置	A. to put	B. steady	C. position	D. I don't know
16	补偿	A. to taste	B. to fix	C. to compensate	D. I don't know
17	喘气	A. to breathe	B. to worry	C. to be angry	D. I don't know
18	兑现	A. understand	B. fulfill	C. appear	D. I don't know
19	共鸣	A. resonance	B. scream	C. common	D. I don't know
20	火焰	A. fire station	B. volcano	C. flame	D. I don't know
21	惊动	A. move	B. alert	C. cool	D. I don't know
22	辽阔	A. vast	B. generous	C. far	D. I don't know
23	配偶	A. equipment	B. spouse	C. occasion	D. I don't know
24	全局	A. police station	B. contract	C. overall situation	D. I don't know
25	示意	A. hint	B. show	C. attention	D. I don't know
26	妥协	A. Cooperation	B. compromise	C. Convenience	D. I don't know
27	销毁	A. Destroy	B. sales	C. Message	D. I don't know
28	荧屏	A. Happiness	B. screen	C. Flame	D. I don't know
29	证书	A. Proof	B. contract	C. Certificate	D. I don't know
30	走漏	A. walk around	B. leak	C. Damp	D. I don't know

Part 3 Grammar

tā cái mǐ wǒ tā gāo

1、他 才 1.70 米，我_____他 高。

bǐ bù rú gèng hěn

A. 比 B. 不如 C. 更 D. 很 E. I don't know

wǒ shì zuó tiān qù běi jīng bú shì qián tiān

2、我 是 昨 天 去 北 京_____，不 是 前 天。

le guò de zhe

A. 了 B. 过 C. 的 D. 着 E. I don't know

mèi mèi bēi zi dǎ pò le

3、妹 妹_____杯 子 打 破 了。

gěi bǎ bèi ràng

A. 给 B. 把 C. 被 D. 让 E. I don't know

nǐ tīng wài miàn hǎo xiàng rén zài qiāo mén

4、你 听，外 面 好 像 _____人 在 敲 门。

yǒu shì zài

A. / B. 有 C. 是 D. 在 E. I don't know

yīn wéi yào qù kǎo shì suǒ yǐ wǒ míng tiān qù kāi huì

5、因 为 要 去 考 试，所 以 我 明 天_____去 开 会。

bù méi méiyǒu

A. 不 B. 没 C. / D. 没 有 E. I don't know

diàn shì jī wǒ nòng huài le

6、电 视 机_____我 弄 坏 了。

shǐ bǎ bèi

A. 使 B. 把 C. 被 D. / E. I don't know

tiān qì zěn me lěng tā jiān chí xǐ lěng shuǐ zǎo

7、_____天 气 怎 么 冷，他_____ 坚 持 洗 冷 水 澡。

bùguǎn háishì wúlùn hái

A. 不 管；还是 B. 无论；还

rú guǒ yě suīrán què

C. 如果；也 D. 虽然；却 E. I don't know

wǒ shàng xué

8、我_____ 上 学。

měi tiān bā diǎn zhōng zǎo shang zǎo shang bā diǎn zhōng měi tiān

A. 每 天 八 点 钟 早 上 B. 早 上 八 点 钟 每 天

měi tiān zǎo shang bā diǎn zhōng bā diǎn zhōng zǎo shang měi tiān

C. 每 天 早 上 八 点 钟 D. 八 点 钟 早 上 每 天

E. I don't know

bà ba sòng wǒ yí gè hěn piàoliang de shēng rì lǐ wù

9、爸爸 送 _____我 一 个 很 漂 亮 的 生 日 礼物。

gěi bǎ bèi ràng

A. 给 B. 把 C. 被 D. 让 E. I don't know

lǎo shī ràngwǒ qù bàn gōng shì ná zuò yè
10、老 师 让 我_____去 办 公 室 拿 作 业。
shì yǒu zài

A. 是 B. / C. 有 D. 在 E. I don’t know

http://www.tclt.us/journal/2019v10n2/valdebenitochen.pdf pp. 61-81

Technology as Enabler of Learner Autonomy and Authentic Learning in Chinese Language Acquisition: A Case Study in Higher Education (利用科技推动中文习得的自主性和真实性——高等教育个案研究)

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Abstract: Based on the Constructivist approach, meaningful learning only occurs when learners have agency to construct meaning through social interactions. The ability to self-direct, communicate, collaborate, and transfer learning to real-life situations are crucial skills for the 21st century. These skills allow new generations to adapt to this new information era in any field and/or disciplines they pursue; foreign language acquisition is not an exception. In this article, the authors argue that language learning can help learners cultivate such abilities with the aid of a holistic curriculum design and the effective use of technology. The authors also explore how using tools, such as Google MyMaps, WordPress, and Adobe Spark, in a semester-long "Food Project" may promote learner autonomy and authentic learning, as well as improve the acquisition of 21st century skills. Technology-based curricular strategies, work progression, and student feedback are presented in the article. Through qualitative analysis, the authors conclude that by focusing on authentic learning and learner autonomy using instructional scaffolding students can enhance linguistic literacy, create a sense of ownership, sharpen cultural awareness, transform interdisciplinary skills, and establish a supportive learning community in the process.

摘要: 建构主义学派认为，学习是学习者透过社会文化互动，将知识经验内化并从中建构意义的过程。在二十一世纪的信息时代中，自主学习、沟通合作、知识迁移和转化都是在各个领域中不可或缺的素养。作者认为，这些技能不但在语言学习中扮演重要角色，另一方面，完善的课程设计和有效的科技应用亦能加强这些能力的培养。本文介绍如何将"食物与文化"的课程设计与科技媒体相互搭配，以提高中文学习过程中的自主性和真实性。透过质性分析，从学生的表现和反馈中可以看出，支架式教学设计以及多媒体工具的辅助能有效提升学生的语言能力，提高学生的学习自主权和文化敏感度，并提升跨领域和知识转移的能力，同时在学习过程中建立起相互支持的学习社群。

Keywords: Language and technology, Constructivism, scaffolding, ZPD (zone of proximal development), learner autonomy, authentic learning

关键词: 科技与语言、建构主义、支架式教学、近侧发展区、学习自主性，真实性学习

1. Introduction

With the arrival of computers and the internet, access to information has increased worldwide, starting the information era. As a response to this new phenomenon, many organizations have attempted to inform society of new needs brought about by this change. Among them, the International Society for Technology in Education (ISTE) has made a major contribution to this conversation by creating the ISTE standards (ISTE, 2019), initially known as 21st-century skills. These standards are essential abilities that individuals should strive to achieve in order to properly adapt to new world needs. At the same time, constructivism has emerged as a teaching and learning philosophy due to its focus on social and active learning. Constructivism can enable authentic learning experiences since its core lies within social interactions. Furthermore, many researchers (Phillips, 1995; Airasian & Walsh 1997; Tam 2000) have reported that a certain level of learner autonomy is needed to transform the learning experience. This paper aims to report back on using a constructivist approach to implement technology in curriculum design, and how it promotes learner autonomy and authentic learning.

2. Literature Review

2.1 Learner Autonomy

In constructivism, knowledge is not a set of "facts" but integrated information that is actively constructed and is constantly evolving in a learner's mind (Phillips, 1995; Airasian & Walsh 1997; Tam 2000). In other words, instructors cannot directly "give" knowledge to learners, but learners play a central role in processing old and new information, along with their experiences, to construct evolving knowledge. As Bada and Olusegun (2015) concluded, "this constructivist view of learning considers the learner as an active agent in the process of knowledge acquisition" (p. 66). To apply this approach to language learning, Little (2007) defined the essence of learner autonomy as "the ability to take charge of one's own learning" (p. 15). He emphasized that "the development of learner autonomy and the growth of target language proficiency are not only mutually supporting each other but are fully integrated with one another." In other words, when language learners are fully in charge of their own learning, not only is the target language proficiency effectively enhanced, but also is their positive identity as autonomous learners.

Little (2007) also applied three important teaching principles to enhance learner autonomy, namely "learner involvement," "learner reflection," and "target language use." Learner involvement "requires that the teacher draws her learners into their own learning process, making them share responsibility for setting the learning agenda, selecting learning activities and materials, managing classroom interactions, and evaluating learning outcomes (Little, 2007). It is clear that learner involvement is not a spontaneous and one-time teaching moment, but a process that requires thorough proactive planning, careful and adjustable implementing, and reflective and mindful evaluation. By doing so, the instructors "provide suggestions and procedures that lie beyond their (the learners) experience, cultivating a classroom dynamic that constantly lifts them to new levels of effort and achievement" (Little, 2007, p. 24). This view resembles the core concept of zone of proximal development (ZPD) and scaffolding in the constructivist learning approach (Vygotsky, 1980).

When talking about "learner involvement," it is inevitable to include "learner reflection," which refers to the state of mind when learners are deeply engaged in the learning process (Little, 2007; Little & Legenhausen, 2017). It is suggested by Little that structured and planned "reflective interventions" should also be addressed in the teaching-learning process to encourage students to engage reflectively with the process and content of their learning. Enhancing learners' capacity to reflect on content and the learning process can also increase the sense of ownership in their overall learning experience. As has been discussed by many language acquisition theorists (e.g., Ellis, 2003), the principle of "target language use" is especially crucial for language learning. Based on the constructivist learning approach, a second language is best acquired when it is practiced as part of social interactions (Marlowe & Page, 2005) and when it is used as a metacognitive tool to reflect on and process the learned information (Little, 2007). In other words, only when the learners see the target language as a medium for communication and reflection can they truly become autonomous producers of the target language.

2.2 Authentic Learning

It is generally acknowledged that language acquisition is not an independent activity of learning words and grammar structures; rather, it is a process of enculturation in which authentic activities and social interactions are the central components of learning (Brown, Collins, & Duguid, 1989). In addition, the constructivist approach illuminates that learning is an active and social process in which learners construct new knowledge with prior experiences and newly encountered ideas. Therefore, an authentic learning environment encourages learners to make connections between learned information and the real world. However, it is widely recognized that current textbooks are often a poor representation of the real world (Gilmore, 2007). Yet, having authentic materials does not instantly make an authentic environment if they are only followed by memorization and comprehension activities (Ozverir & Herrington, 2011). Instead, the original purpose of the authentic materials should be realized by exchanging information between the author and reader, and by constructing meaning that is relevant to real life. Hence, Gilmore (2007) suggests that to create an authentic learning environment, a holistic curriculum design will

be needed. To help connect the classroom to the world, Herrington, Oliver, and Reeves (2003) identified ten characteristics of authentic activities:

> (1) have real-world relevance; (2) are ill-defined, requiring students to define the tasks and sub-tasks needed to complete the activity; (3) comprise complex tasks to be investigated by students over a sustained period of time; (4) provide the opportunity for students to examine the task from different perspectives, using a variety of resources; (5) provide the opportunity to collaborate; (6) provide the opportunity to reflect; (7) can be integrated and applied across different subject areas and lead beyond domain-specific outcomes; (8) are seamlessly integrated with assessment; (9) create polished products valuable in their own right rather than as preparation for something else; and, (10) allow competing solutions and diversity of outcomes (p. 4-5).

To apply these characteristics to language learning, learners create work based on their own interests and real-world relevance through a sustainable process of collaboration, reflection, use of multiple resources, and drawing on interdisciplinary skills. Through this process, learners have an opportunity to investigate topics that matter to them and to acquire skills and knowledge beyond language learning.

2.3 Technology in Education

Technology has become an integral part of our lives and, consequently, an unavoidable part of the educational system. Technology allows us not only to access a wide array of information, but also enables us to share knowledge with others. The mere action of sharing information online can transform learners into active co-producers of content. This can help students become motivated and empowered in the creation of sustainable knowledge networks, enabling desired learning outcomes, and augmenting the learning experience (Blumenfeld et al., 1991; Dabbagh & Kitsantas, 2012). In their influential book, *How People Learn*, (Bransford, Brown, & Cocking, 2000) went even further and concluded that there are five ways to establish effective learning environments using technology. These five ways are described as: "bringing real-world problems into the classroom setting, providing scaffolding support throughout the learning process, increasing feedback opportunities, building communities (locally and globally), and expanding teacher's learning opportunities" (p. 243).

As an engaging tool, technology encourages students to shift from passive learners to active learners by allowing them to create their personal materials (Suwantarathip & Wichadee, 2014). While participating in technologically supported activities, students think about themselves as active contributors to knowledge instead of passive recipients of information. In addition, by participating in interdisciplinary projects using technology, students can not only achieve collaborative skills but other important 21st century skills, such as problem solving, creativity, data management, and communication as well (Moeller & Reitzes, 2011). The use of technology can also enhance critical thinking, conceptual connections, and mastery of knowledge and skills (Moeller & Reitzes, 2011).

Such skills align with many of the International Society for Technology in Education (ISTE) standards: empowered learner, digital citizen, knowledge constructor, computational thinker, innovative designer, creative communicator, and global collaborator (ISTE, 2019). These standards aim to guide the development of curriculum around technology, implying that technology can have a certain importance in enhancing the learning process. At the very least, as Scardamalia and Bereiter (1993) mentioned, technology has the potential to alter educational discourse by adding variety and dynamism to the teaching and learning process. As to the field of language teaching and learning, there have been multiple reports that analyze and recognize the positive effects of instructional technology use. Video development (Ariew, 1987; Gardner, 1994; Nikitina, 2009, 2010), map visualizations (Lamb & Johnson, 2010; Patterson, 2007), and online blogging (Elola & Oskoz, 2008; Miyazoe & Anderson, 2010) are a few examples of the widely discussed tools that we will be using in our project.

To ensure the effective incorporation of technology and pedagogy, researchers have studied the implementation of several conceptual frameworks, one being the SAMR (substitution, augmentation, modification, redefinition) model (Hamilton, Rosenberg, & Akcaoglu, 2016). This model creates an opportunity to evaluate the use of technological tools and the impact that they may have in the learning process. As part of this evaluation, modification (technology enabling a significant task redesign) and redefinition (technology enabling the creation of new tasks that before were inconceivable) appear as the two higher levels on the model. They are described as levels that transform the educational experience. As other research and studies have reported, the empirical evidence leads us to believe that technology plays a role in supporting the learning process. We believe technology is here not to replace pedagogy but rather to support it. With this in mind, this paper will use the social constructivist approach as the groundwork to develop strategies with implications for cognitive development. Furthermore, we will use the SAMR model to show how technology enables students to work on new tasks that best engage them in constructing knowledge in community.

3. Theoretical Framework

3.1 Zone of Proximal Development and Scaffolding

Constructivist theory proposes that knowledge and understanding occurs first at a socio-cultural level and then at an individual level (Vygotsky, 1980). Vygotsky also pointed out that “the most significant moment in the course of intellectual development, which gives birth to the purely human forms of practical and abstract intelligence, occurs when speech and practical activity, two previously completely independent lines of development, converge” (Vygotsky, 1980, p. 24). This constructivist approach illustrates how problem solving and collaboration are key to improving learners' cognitive development. In his analysis of the interactions between learning and development, Vygotsky specifies that the zone of proximal development (ZPD) is a formula to enable “good learning,” in which there is progress in the individual’s cognitive development. This

conceptual approach has the capability to converge efforts and guide curricular enactments in second language learner environments (Schwieter, 2010).

ZPD is understood as the developmental area that can be achieved with the assistance of a mentor or teacher. It is an area that a given person is unable to achieve by their own means (Vygotsky, 1980). As Vygotsky noted, "what is in the zone of proximal development today, will be the actual developmental level tomorrow" (p. 87). This constitutes the foundation of what researchers understand by scaffolding. The concept of scaffolding introduced by Wood, Bruner, and Ross (1976) attempts to guide cognitive development by creating consciousness of the need to break down learning goals into stages that, although challenging to learners, are within a reachable distance in their ZPD. In addition to instructional guidance, peer collaboration and support are important to achieve a positive learning experience. As Wass and Golding (2014) remarked, "scaffolds might include offering the opportunity for peer support where students can observe and copy how a peer solves similar problems, getting peer feedback about the effectiveness of their strategies, or collaboratively inventing new strategies." Wass and Golding (2014) also highlighted in their conceptual analysis that the use of ZPD is not widespread in higher education. Nevertheless, that is not to say there is no value in applying its criteria in the development of a given curriculum at this level.

We have discussed how learner autonomy and authentic learning are crucial for positive language learning experiences and how scaffolding can help learners reach their ZPD. To apply this theoretical position to a practical situation, this project aimed to help students to: (1) creatively apply their language skills to authentic settings; (2) deepen their cultural and linguistic literacies by putting language use into real-world contexts; (3) encourage student autonomy through choosing their topics as well as developing a digital product; (4) foster a collaborative learning community; and (5) encourage students to develop and express multi-literacy through the use of different technologies. In this paper, we will report on the implementation plan and the selected tools we used throughout the learning process of carrying out the Food Project. The project was introduced to an intermediate Chinese course at a higher education institution. There were 33 participants in a period lasting one semester. We will share student feedback and authors' reflections to provide a deeper understanding of how this curriculum design with technological implications impacts learning and teaching.

3.2 Scaffolding the Learning Experience

As can be seen in Figure 1, the Chinese Food Project had an implementation plan that required an entire semester. The project was presented on the first day of class, and it was followed by an Adobe Spark workshops week 3. At mid-semester (weeks 6 and 7), students started reading sessions to review previous lessons, which also prepared them to write their proposal. Between weeks 9 and 12, students wrote their first draft and completed three revisions. Google MyMaps and WordPress workshops were also held during this time. After written drafts were completed, students had two weeks (weeks 13 and 14) to create digital narratives before the screening and discussion in the final week. The authors will illustrate the details of how each phase was implemented in the following section.

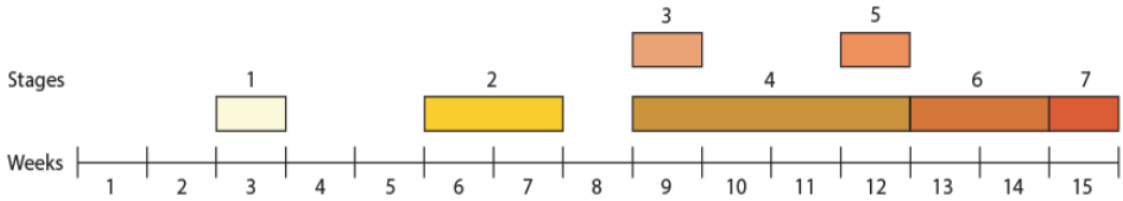


Figure 1 A breakdown of the semester-long plan for the Food Project

Stage 1. Week 3: Video tool workshop (Adobe Spark)

Shortly after explaining the Food Project on the first day of class, Adobe Spark, the video making application, was introduced. In addition to practicing how to make videos, students also learned about how to locate and legally use digital resources such as images and videos. As a follow-up assignment, students were asked to produce a short video about traditional foods for Chinese New Year corresponding to the current lesson topic "Chinese Spring Festival." This also served as the first step for students to familiarize themselves with the technology through a micro-task related to the Food Project. Throughout the semester, students had other video presentation opportunities to practice using the tool before the final project was due.

Stage 2. Weeks 6 and 7: Mid-semester review

During this stage, the textbooks were put aside and replaced with food-related reading materials. The narratives are designed to review previous topics and preview upcoming lessons. There were two types of narratives used: instructor-created narratives and essays from former students. The following are some examples:

(1) "素食天堂-台湾" (c.f. Appendix A and B): This instructor narrative talks about the religious and cultural background of traditional vegetarian food in Taiwan and how it evolved to become a versatile cuisine and an indication of social and lifestyle changes in modern times. Students learned about traditions, culture, and social changes through reading text, watching videos, doing reading exercises, discussing questions, reflecting on their own culture and personal experiences, and developing a similar narrative as preparation for the final project.

(2) "The Lobster in Maine" (c.f. Appendix C): This student narrative talks about changes in social perspective toward lobsters in Maine, which is intertwined with the history and economy of the local community. The goal of assigning former students' essays was to provide potential topics and perspectives, and also to motivate current students to develop a polished end product, as referenced in the student feedback below.

> *I really liked the chance to read other [former) students' essays. It gave me inspiration to write my own and helped me see how much I had learned so far this semester.*
> *Discussing previous students' work is one of the most helpful activities. It helps us have a general idea of what our projects should look like and learn*

from some mistakes/things we disliked about theirs. By doing this, it helped me realize I wanted to change my proposal.

After exploring and brainstorming potential themes, students decided on the food topic based on their own interests. The review week aimed to scaffold students' linguistic knowledge and cultural literacy, and paved the way for the final food essay through guided reading and writing exercises as well as small group discussions.

Stage 3. Week 9: Google MyMaps workshop

After students had their topic and outline ready, a Google MyMaps workshop was conducted to help students visualize the context of their writing by marking the region(s) related to their food topic. Having a different way to present their topic also gave students an opportunity to reflect on their ideas. Additionally, working on a shared map allowed the students to see each other's work and set the tone for a collaborative learning environment.

Stage 4. Week 9 to 12: Writing sessions and draft revisions

After receiving feedback on their proposals at the end of the review week, students started a three-draft writing process. Proofreading groups were formed to create a sense of an authentic audience and writing community. Students submitted each draft through Google Docs, where exchanges of comments and documentation of the writing process took place. In addition to receiving instructor and peer feedback on each draft, writing sessions and small group meetings were held during class time to provide more guidance and assistance.

Stage 5. Week 12: WordPress workshop

After students completed their final draft, a WordPress workshop introduced students to the blog site where they would post their final essay and video at the end of the semester. WordPress allowed students to document their progress and to showcase their work, this time with the addition of multi-module media such as text, images, and videos. The workshop also reinforced the adequate use of digital resources, gave students a glimpse of what the end product would look like, and signified that the project had moved towards the final stages.

Stage 6. Weeks 13-14: Video production

Before the final screening week, students had two weeks to polish their writing and create a digital narrative video using Adobe Spark or any other video making tools of their choice. In addition to paying attention to their linguistic proficiency, such as pronunciation and tones, students also exercised their digital literacy by being allowed decision-making over multimedia choices (i.e. music and image) to present their ideas. They also practiced their information literacy by properly locating and using digital resources. Additionally, the process of making digital narratives allowed students to reflect on their written work and document their learning outcomes.

Stage 7. Week 15: Screening and discussion

During the final week, students took turns sharing their final video and answered peers' questions. In addition to verbal exchanges, written feedback and questions were submitted through a shared Google Doc. These questions were used as part of the final exam.

As illustrated above, the development of the project took a whole semester. All the phases and workshops were put together like jigsaw pieces to best scaffold students' learning experiences in order to achieve the project learning goals.

4. Achieving Learning Objectives with the Assistance of Technology

In order to establish effective learning through the use of technology, we followed the previously mentioned five principles created by Bransford et al. (2000) and introduced several tools to the class to develop the project. Though Google Docs was also used as part of this project, the authors will focus on the technologies that fall under the modification and redefinition categories in the SAMR model. These categories are believed to be capable of enabling a transformation of the educational experience. Furthermore, although we understand there are many tools that could work for the teaching purposes of this project, the authors chose to make use of three tools supported by the instructional technologists at the college. These tools were: Google MyMaps, WordPress, and Adobe Spark.

A. Google MyMaps

Google MyMaps is an application in the Google suite that allows users to create pins, shapes, and lines on a custom map. These elements could also include descriptions, images, and videos. This tool enables a space for synchronous and asynchronous collaboration. The students' task was to share their work using this tool; for that purpose, a single class map was provided.

Google MyMaps provides an authentic learning environment in which students apply their cultural literacies to a real-world map and examine food culture through geographical context. It also encourages students to reflect on their thinking and creating process through making the connections between food and its geographical distribution. Working on the collaborative map can also strengthen the learning community by allowing students to observe how individuals' food topics connect with each other. Student feedback revealed a positive impact of using Google MyMaps for this project:

> *"I liked being able to see the map with everyone's pins on it, to observe the geographical distribution of the foods we were learning about."*

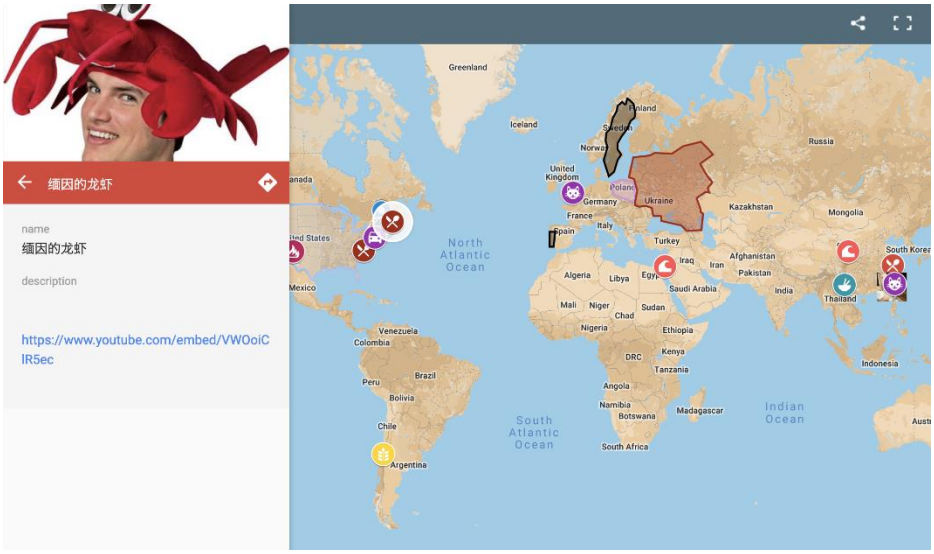


Figure 2 A screenshot of the pins and areas of interest on the shared Google MyMaps

B. WordPress

WordPress is an open source content management system that enables the publication of websites and the creation of web content with the aid of a user friendly WYSIWYG (what you see is what you get) editor. In this project, a private website was developed by both the faculty and the instructional technologist. Enjoying an "editor" role on the site, students focused on the development of two blog entries, including a proposal and final product.

The WordPress site served as a collaborative platform where students were allowed to share progress on their work and ideas with their peers. It hence established an authentic readership. It also documented and highlighted the progress students made throughout the semester. Furthermore, through choosing and integrating multi-module media on their own blog posts, students improved multimodal literacy and digital literacy while reinforcing their learner autonomy. At the end of the semester, the outstanding products were also posted on a public Food Project site to connect with a wider global audience. Student feedback revealed how WordPress gave students a sense of achievement, ownership, and learning community. Feedback inlcuded the following remarks:

> *"Seeing the progress on the wordpress* [sic] *was super great!"*

> *"I really like WordPress and Google MyMaps so that I could see geographically where everyone's food came from and could see their project in blog form."*

WordPress served as the host of the class final project. This included their project narratives, the Google MyMaps pins, and their final videos. At the end of the semester, using selected student projects, a public website was created: http://sophia.smith.edu/chinese-food-project (Figure 3).

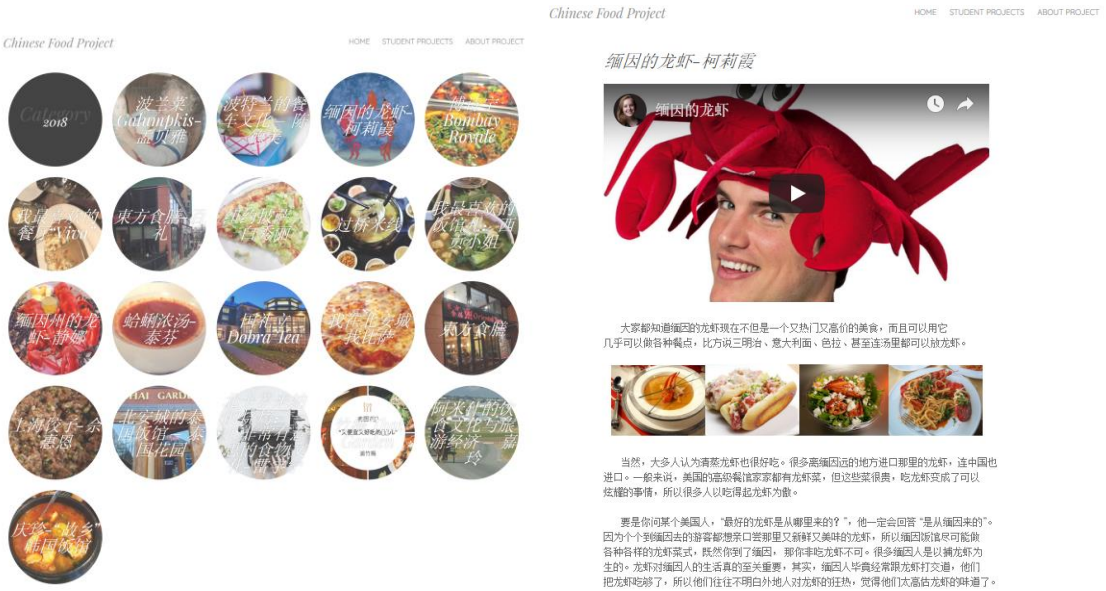


Figure 3 Screenshots of the Chinese Food Project WordPress site
The left side depicts featured images from each project. The right side shows a single project view, including video, images and narrative.

C. Adobe Spark

Several video editing tools were available to students. Many of them had experience using tools such as Explain Everything and/or WeVideo. Students were welcomed to use those tools on their final project. The curricular plan had, however, Adobe Spark as the preferred tool for the project. Adobe Spark is a free web-based application that enables the development of video stories (or digital narratives) within a user-friendly interface.

Making digital narratives encouraged students to practice and evaluate their pronunciation when reading the script out loud. The process of recording also encouraged students to reflect on their writing, reading, and speaking skills. Besides documenting the learning process, students exercised digital literacies by implementing proper multimodal media to deliver their ideas. Sharing and discussing the videos during the screening sessions strengthened the learning community and enhanced students' cultural and linguistic literacy. Student feedback revealed how making videos helped them improve their linguistic, cultural, and digital literacy skills:

> *"Making videos and having to listen back to the pronunciation definitely helped me to see what mistakes I was making."*

> *"Having to read the whole narrative out loud forced me to review the pronunciations for many words that I had overlooked before or hadn't taken the time to practice speaking."*

> *"The viewing party on the last day of class allowed me to watch others videos and not only learn about my fellow classmate(s) but also practice listening and learning about culture as well"*

5. From Theory to Practice: The Impact on Learners

5.1 Language Proficiency

One of the core objectives of this project was to enhance students' language proficiency. Through the reading sessions, writing exercises, and video making process, students enlarged their linguistic capacity in reading, writing, and speaking skills.

> *"The food project taught me how to properly write essays in Chinese and improved my writing skills. Also, my vocabulary has expanded along with my knowledge on grammar structures."*

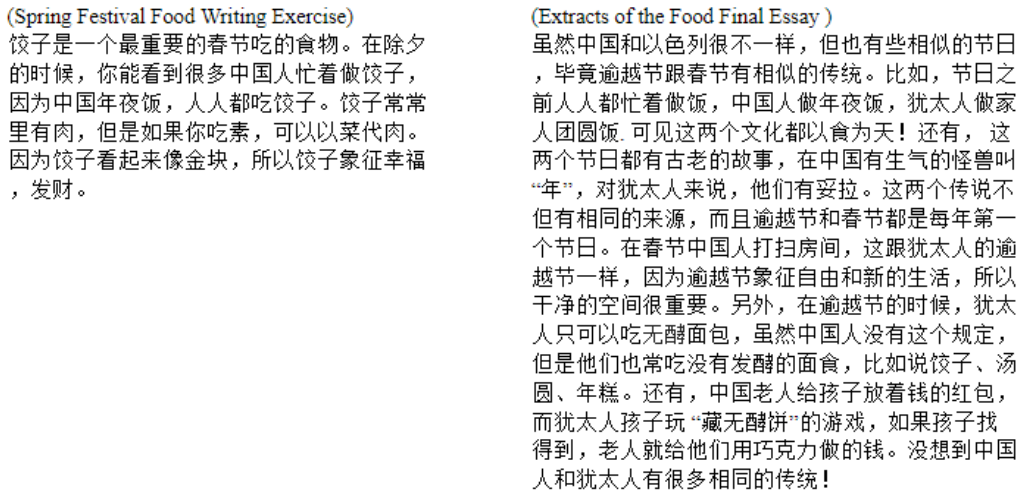
> *"I think the assignment was effective because it allowed me to practice my speaking skills as I created my own video, and my listening skills as I watched my classmates' videos."*

Furthermore, the project helped students gain a deeper understanding about Chinese food and develop their cultural awareness, which is a crucial element in foreign language acquisition. It also encouraged students to explore and learn more about the culture.

> *"I learned about Taiwanese vegetarian food culture, which was something I was completely unaware of."*

> *"This was a great way to learn more deeply about Chinese culture. Utilizing sources that weren't necessarily for a language learner made me excited to travel and utilize language skills."*

From the mini video draft in week three to the final food essay at the end of the semester, students made impressive progress in terms of the complexity of sentence structures, the maturity of the narrative development, and the depth of their culture awareness (see Figure 4). These results resonate with Vygotsky's zone of proximal development theory, in which students were able to achieve these desired results with appropriate scaffolding.


(Spring Festival Food Writing Exercise)
饺子是一个最重要的春节吃的食物。在除夕的时候，你能看到很多中国人忙着做饺子，因为中国年夜饭，人人都吃饺子。饺子常常里有肉，但是如果你吃素，可以以菜代肉。因为饺子看起来像金块，所以饺子象征幸福，发财。

(Extracts of the Food Final Essay)
虽然中国和以色列很不一样，但也有些相似的节日，毕竟逾越节跟春节有相似的传统。比如，节日之前人人都忙着做饭，中国人做年夜饭，犹太人做家人团圆饭. 可见这两个文化都以食为天！还有，这两个节日都有古老的故事，在中国有生气的怪兽叫"年"，对犹太人来说，他们有妥拉。这两个传说不但有相同的来源，而且逾越节和春节都是每年第一个节日。在春节中国人打扫房间，这跟犹太人的逾越节一样，因为逾越节象征自由和新的生活，所以干净的空间很重要。另外，在逾越节的时候，犹太人只可以吃无酵面包，虽然中国人没有这个规定，但是他们也常吃没有发酵的面食，比如说饺子、汤圆、年糕。还有，中国老人给孩子放着钱的红包，而犹太人孩子玩"藏无酵饼"的游戏，如果孩子找得到，老人就给他们用巧克力做的钱。没想到中国人和犹太人有很多相同的传统！

Figure 4 A comparison between two written assignments from the same student: One writing assignment at the beginning of the semester (left) and an excerpt of the final essay (right)

5.2 Learner Autonomy

As addressed in the literature review, increasing student learner autonomy can not only enhance their target language proficiency but also their positive identity as successful learners. Choosing a project topic based on personal interests encouraged learner autonomy and personalized learning.

> *"I definitely explored a food that had personal significance to me and my family history, and I think many other students did so as well."*

> *"I think it was nice that we had so much freedom in choosing the food we wanted to focus on and also the content we wanted to focus on in the essay."*

Additionally, when producing their videos and blog posts, students needed to evaluate and select multimedia to best deliver their narratives. Through using tools such as Google MyMaps, WordPress, and Adobe Spark, students could observe their own progress and reflect on the work that had been done. Moreover, the project was broken down into a step-by-step process, which helped students manage the challenging tasks. It also scaffolded their learning experiences while allowing them to gain a sense of success and confidence.

> *"This project really pushed me to work on my writing skills in other ways classes before hadn't. I really liked this project and I feel like I learned a lot."*

> *"I definitely improved my ability to write essays in mandarin in this project and my writing was more complex then* [*sic*] *I had ever done before."*

By providing opportunities for students to create and reflect on a product that is personal to them, students' learner autonomy flourished. By scaffolding the project as a step-by-step process, positive and empowered learner identity was formed.

5.3 Authentic Learning

Authentic learning sets up an environment in which students can apply learned knowledge and skills to a real world context. When choosing a food topic that is dear to themselves and exploring its relationship with culture, students had an opportunity to work with materials that are closely woven into their lives.

> *"It was very interesting to write about my culture in Chinese, sometimes it was hard to express what I mean, but this activity improved my writing skills a lot."*

> *"*(The Food Project impacted my Chinese learning by) *applying knowledge to concrete manifestation, going beyond textbook comprehension."*

The following tools were used to enhance authenticity: Google MyMaps provided the geographical and spatial contexts of food; peer-editing on Google Docs encouraged purposeful writing to effectively communicate their thoughts with the readers; WordPress showcased students' work to authentic audiences potentially beyond their peers. The peer-review process, MyMaps marking, and video discussion activities also fostered collaboration among peers, which is identified as one of the characteristics of authentic learning. Subsequently, consistent collaboration helped students form a tight-knit learning community.

> *"The peer–editing process was painful, but it was helpful in gauging the sort of audience interest and level of understanding to make our own work relatable."*

> *"I liked the sense of learning community that came from seeing all the other videos and learning about the importance of all the other foods. It was really fun."*

> *"It was great for building a sense of learning community because we all helped each other outside of class."*

Authentic learning also encouraged interdisciplinary perspectives and provided opportunities to reflect. From student feedback, we could see how this project promoted integrative knowledge from different fields as well as soft skills such as communication and task management.

> *"Not only was it good practice for my Chinese skills, it was also a great way to learn more about the cultural, historical, and personal significance of a food."*

> *"My biggest takeaway is in structuring time and breaking down larger work into smaller work."*

Furthermore, the project fostered students' critical thinking and stimulated reflection on their own culture as well as learning experiences. The feedback below from the first student revealed how this project made students rethink the culture they took for granted. In the feedback from the second student, who took first-year Chinese, the student shared how the video making process helped her see the growth and progress from the previous year.

> *"It made me question my culture what changes occur and how we should respect each other's cultures, because they are important."*

> *"*(The reward) *is the permanence of the videos in documenting my progress in Chinese* [*sic*]. *I get to hear my first year and now second year Chinese* [*sic*] *videos"*

Lastly but most importantly, developing the Food Project with interdisciplinary perspectives guided students to move beyond the textbook to conceptualize the world around them using the target language. As referenced in the first student's feedback, students enjoyed working outside of textbooks. The following statements are quoted from the Food Project final essay, which shows how this project brought out what was of personal significance and how they conceptualized food culture closely associated with their lives.

> *"It was really nice to not use the textbook, I felt like I could think and write more on my own."*

> *"我喜欢路边的小吃馆，不是因为他们的食物，而是为它们热闹的气氛。它们的饭很简单，也让我想起来我爱的家庭。还有，路边小吃馆欢迎每个顾客，不同背景的人一起吃饭表现出美国文化里对不同背景的尊重。" (I like the diners off the streets, not because of their food, but their vibrant atmosphere. The food is very simple, and reminds me of my beloved family. The diners welcome every customer. People from different backgrounds eating together shows how U.S. culture embraces and respects different cultures.)*

> *"對那些從台灣移民到別的國家的人來說，珍珠奶茶可能是一種讓他們懷念故鄉的飲料，而我們這些第二代的年輕人以喝珍珠奶茶來聯繫我們與亞洲背景的聯繫。" (For those Taiwanese people who immigrated to other countries, bubble tea might be a drink that reminds them of their hometown; for us the second generation, drinking bubble tea connects us to our Asian heritage.)*

6. Conclusions

The Food Project aimed to create a holistic curricular design with a special focus on enabling the 10 characteristics presented by Herrington et al. (2003). The process described in this paper and the work towards public-scholarship are some examples of the different instances where authentic learning took place. The use of multiple publication tools (Google MyMaps, WordPress, and Adobe Spark) provided extensive opportunities for students to visualize their project using different lenses. The sustained length of this project was also a critical factor in allowing students to have time not only to reflect on their learning experience but also to create a polished product for their public audience. Although difficult to measure, based on the research and our class observations we believe the learning experience created personal significance. Another key factor in this process was enabling opportunities to discuss and present different real-world situations beyond the classroom. This correlates with what Scardamalia and Bereiter (1993) said decades ago, since students were active contributors to creating knowledge. That made the project align with the constructivist approach. As part of this experience, students were empowered to bring their personal ideas and experiences to the project, and play an active role in creating new information. This resulted in a constant transformation of their project as well as an improvement in their Chinese proficiency. This resonates with what was reported by Phillips (1995) and conforms with the essential characteristic of the constructivist approach. Furthermore, as part of this class project, students were able to practice some 21st century skills such as collaboration, communication, problem-solving, and critical thinking (Moeller & Reitzes, 2011; ISTE, 2019).

In addition to those skills, students learned about different online publication platforms and video editing tools. This project aimed to create a holistic approach to curriculum design, as suggested by Gilmore (2007). In the end, qualitative results show a positive impact on the students' learning experience. Within the setting of this course, students were able to move beyond a standard language class into an environment where they were owners of their own learning. As a result, students transformed their language proficiency alongside acquiring multiple 21st century skills.

7. Future Studies

Several items were not covered in this paper. One aspect that may require further exploration is the use of the Google Drive suite for class collaboration, class discussions, formative assessment, and as a channel for feedback on student projects. Google Drive was not included in this paper as the authors believe this tool falls under the augmentation category of the SAMR model (Hamilton et al., 2016). Augmentation is considered an enhancement of a given educational practice, hence, it is not as critical as the modification and redefinition categories. Regardless, we believe it is worthwhile exploring the contribution of online collaboration spaces such as Google Drive in higher education. Another aspect that requires further exploration is the dynamic and relationship between instructional technologist and course instructor. Discussing learning objectives and developing curriculum with an instructional technologist is an area that has not yet been

discussed in second language learning classes. This article does not provide in-depth analysis of this area. We encourage others in the learning community to add to this conversation.

References

Airasian, P. W., & Walsh, M. E. (1997). Constructivist cautions. *Phi Delta Kappan, 78*(6), 444-449.

Ariew, R. (1987) Integrating video and CALL in the curriculum: the role of the ACTFL guidelines. In W. F. Smith (Ed.), *Modern Media in Foreign Language Education: Theory and Implementation* (pp. 41-66). Lincolnwood, IL: National Textbook Co.

Bada, S. O., & Olusegun, S. (2015). Constructivism learning theory: A paradigm for teaching and learning. *Journal of Research & Method in Education, 5*(6), 66-70.

Blumenfeld, P. C., Soloway, E., Marx, R. W., Krajcik, J. S., Guzdial, M., & Palincsar, A. (1991). Motivating project-based learning: Sustaining the doing, supporting the learning. *Educational Psychologist, 26*(3-4), 369-398.

Bransford, J. D., Brown, A. L., & Cocking, R. R. (2000). *How people learn (Vol. 11).* Washington, DC: National Academy Press.

Brown, J. S., Collins, A., & Duguid, P. (1989). Situated cognition and the culture of learning. *Educational Researcher, 18*(1), 32-42.

Dabbagh, N., & Kitsantas, A. (2012). Personal Learning Environments, social media, and self-regulated learning: A natural formula for connecting formal and informal learning. *The Internet and Higher Education, 15*(1), 3-8.

Ellis, R. (2003). *Task-based language learning and teaching*. Oxford, UK. Oxford University Press.

Elola, I., & Oskoz, A. (2008). Blogging: Fostering intercultural competence development in foreign language and study abroad contexts. *Foreign Language Annals, 41*(3), 454-477.

Gardner, D. (1994). Student-produced video documentary: Hong Kong as a self-access resource. *Hong Kong Papers in Linguistics and Language Teaching, 17*, 45-53.

Gilmore, A. (2007). Authentic materials and authenticity in foreign language learning. *Language Teaching, 40*(2), 97-118.

Hamilton, E. R., Rosenberg, J. M., & Akcaoglu, M. (2016). The substitution augmentation modification redefinition (SAMR) model: A critical review and suggestions for its use. *TechTrends: Linking Research and Practice to Improve Learning, 60*(5), 433-441.

Herrington, J., Oliver, R., & Reeves, T. C. (2003). Patterns of engagement in authentic online learning environments. *Australasian Journal of Educational Technology, 19*(1), 279-286.

International Society for Technology in Education. (2019). *ISTE national educational technology standards (NETS)*. Eugene, OR: International Society for Technology in Education.

Lamb, A., & Johnson, L. (2010). Virtual expeditions: Google Earth, GIS, and geovisualization technologies in teaching and learning. *Teacher Librarian, 37*(3), 81-85.

Little, D. (2007). Language learner autonomy: Some fundamental considerations revisited. *International Journal of Innovation in Language Learning and Teaching*, *1*(1), 14-29.

Little, D., & Legenhausen, L. (2017). *Language learner autonomy: Theory, practice and research*. Bristol, UK: Multilingual Matters.

Marlowe, B. A., & Page, M. L. (2005). *Creating and sustaining the constructivist classroom*. Thousand Oaks, CA: Corwin Press.

Miyazoe, T., & Anderson, T. (2010). Learning outcomes and students' perceptions of online writing: Simultaneous implementation of a forum, blog, and wiki in an EFL blended learning setting. *System*, *38*(2), 185-199.

Moeller, B., & Reitzes, T. (2011). *Integrating technology with student-centered learning.* Quincy, MA: Nellie Mae Education Foundation.

Nikitina, L. (2009). Student video project as a means to practice constructivist pedagogy in the foreign language classroom. *Journal of Educators & Education/Jurnal Pendidik Dan Pendidikan*, *24*, 165–176.

Nikitina, L. (2010). Addressing pedagogical dilemmas in a constructivist language learning experience. *Journal of the Scholarship of Teaching and Learning*, *10*(2), 90-106.

Ozverir, I., and Herrington, J. (2011). Authentic activities in language learning: Bringing real world relevance to classroom activities. In T. Bastiaens & M. Ebner (Eds.), *Proceedings of EdMedia: World conference on educational media and technology 2011* (pp. 1423-1428). Norfolk, VA: Association for the Advancement of Computing in Education (AACE).

Patterson, T. C. (2007). Google Earth as a (not just) geography education tool. *Journal of Geography, 106*(4), 145-152.

Phillips, D. C. (1995). The good, the bad, and the ugly: The many faces of constructivism. *Educational Researcher, 24*(7), 5-12.

Scardamalia, M., & Bereiter, C. (1993). Technologies for knowledge-building discourse. *Communications of the ACM, 36*(5), 37-41.

Schwieter, J. W. (2010). Developing Second Language Writing Through Scaffolding In The ZPD: A Magazine Project For An Authentic Audience. *Journal of College Teaching & Learning, 7*(10). Retrieved from https://doi.org/10.19030/tlc.v7i10.154

Suwantarathip, O., & Wichadee, S. (2014). The effects of collaborative writing activity using Google Docs on students' writing abilities. *Turkish Online Journal of Educational Technology, 13*(2), 148-156.

Tam, M. (2000). Constructivism, instructional design, and technology: Implications for transforming distance learning. *Educational Technology & Society*, *3*(2), 50-60.

Voyiatzaki, E., & Avouris, N. (2014). Support for the teacher in technology-enhanced collaborative classroom. *Education and Information Technologies, 19*(1), 129-154.

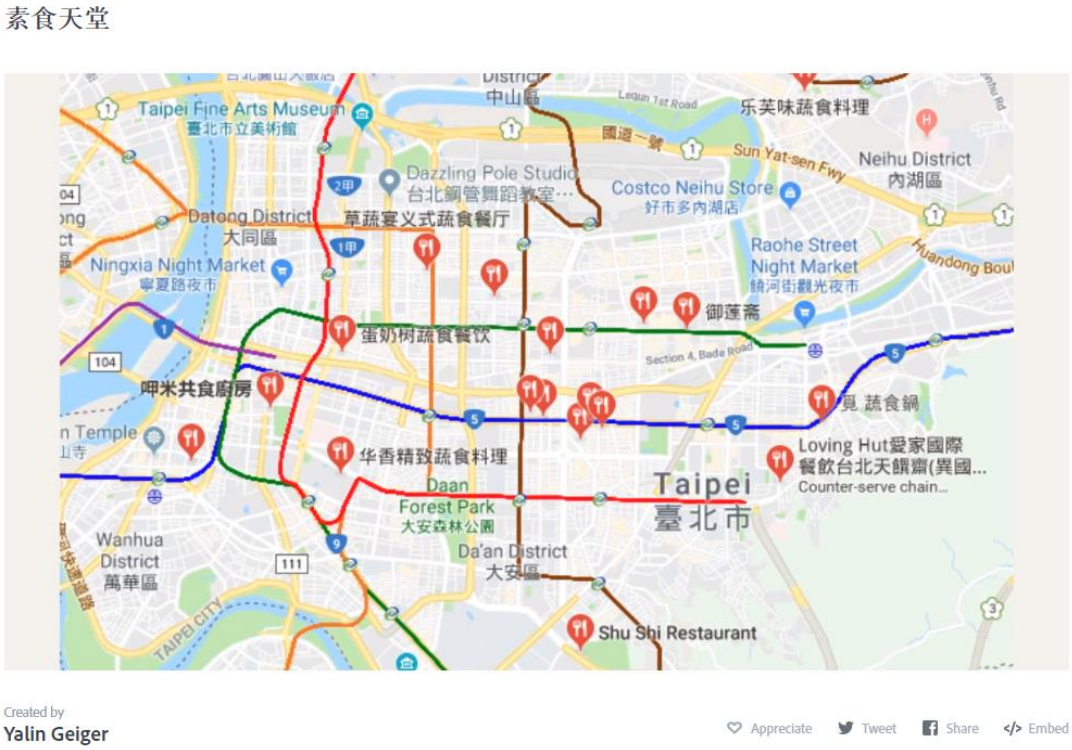
Vygotsky, L. S. (1980). *Mind in society: The development of higher psychological processes.* Cambridge, MA: Harvard University Press.

Wass, R., & Golding, C. (2014). Sharpening a tool for teaching: the zone of proximal development. *Teaching in Higher Education*, *19*(6), 671-684.

Wood, D., Bruner, J. S., & Ross, G. (1976). The role of tutoring in problem solving. *Journal of Child Psychology and Psychiatry, 17*(2), 89-100.

Appendix A

Screenshot of instructor's video



Appendix B

Screenshot of instructor's narrative

This narrative will serve as a mid-semester review for L14. Blue marks the grammar points of L14, red the new vocabulary, and purple the vocabulary you will learn in the following lessons.

1. *Before you read, pay attention to the following words: 素食、佛教、保护、高级、变化*
2. *As you read, look for the general ideas of each paragraph*
3. *After you read, identify the main idea and guess the words you don't know from context*

文章（一）

如果你吃素，或是对吃素有兴趣，千万别错过有"素食天堂"美名的台湾! 只要在这儿的街上随便走走，就能看到一家家林立的素食餐厅。即使你不吃素，台湾的素食特色肯定也会让你留下非常深刻的印象。今天我就来简单地介绍一下台湾的素食文化。

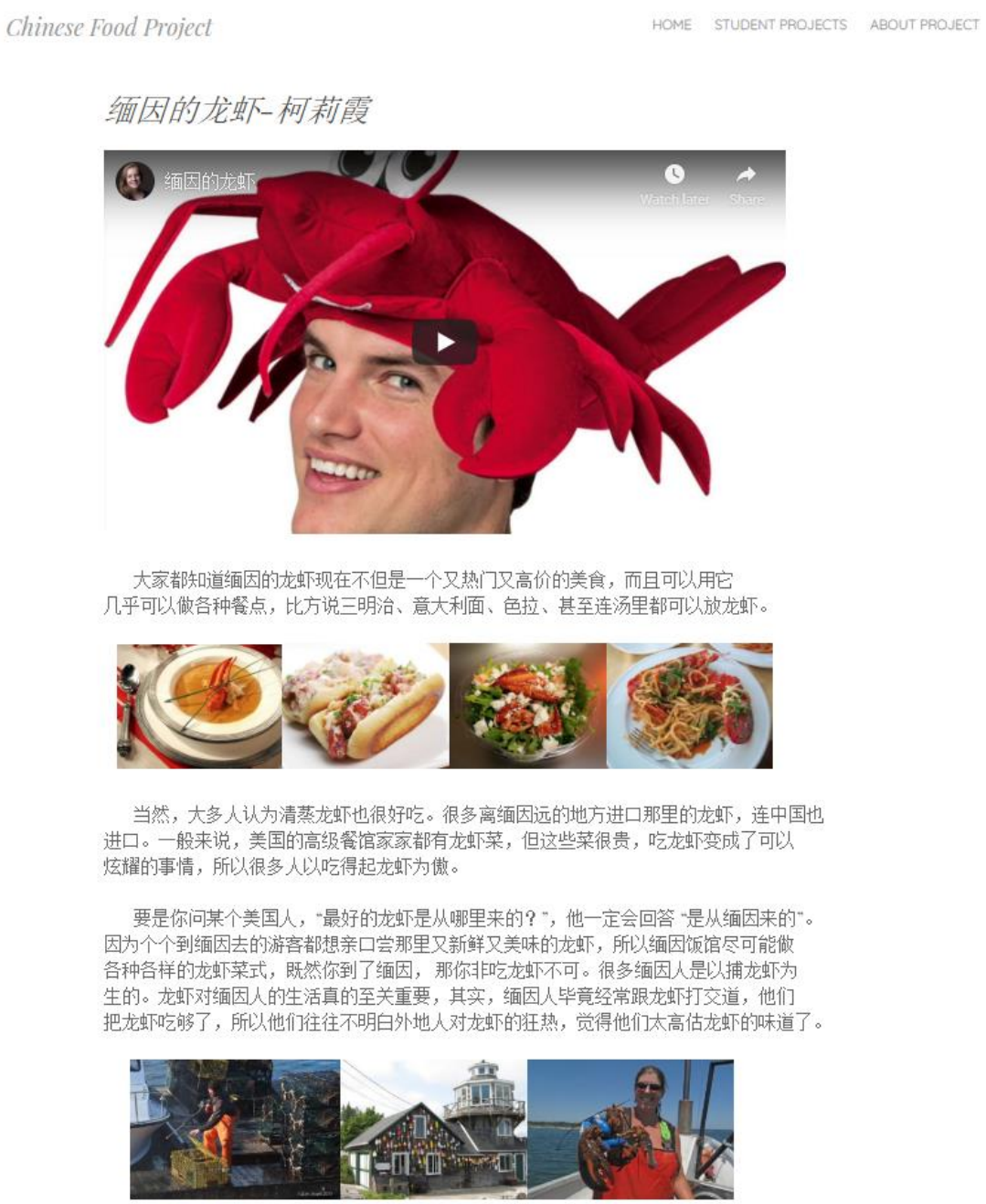
台湾早期的素食文化是受到佛教、道教和传统风俗习惯的影响，除了佛教徒以外，一般老百姓也会在初一十五吃素 (或叫"吃斋")。他们吃的素，不只是不吃肉，也不吃"五辛"，比如葱和蒜。他们吃素是为了感谢佛神庇佑，不杀害其他生命。为了让这些平常不吃素的人也习惯吃素，素菜里常常有用豆子做成的素肉，比如素鸡和素鸭等等。但是从1990年以来，吃素的文化发生了很大的变化。越来越多人开始吃素，是因为注意自己的身体健康，或是为了保护环境、保护动物而开始吃素。这些人有的吃"全素"，除了青菜水果以外什么都不吃，有的吃"方便素"，只要有机会就尽可能吃素，但是偶尔也吃一点肉。同时，台湾政府也鼓励老百姓一个星期选一天不吃肉，除了使更多人知道吃素对环境保护的好处，也改变了很多人＂吃素等于没营养＂的想法。

由于吃素人口的改变，素食餐厅在素菜的做法上有了新的变化，多蒸卤少油炸，以少盐少油来保留最自然的味道，在食材方面也多了很多不同的选择，以最新鲜的青菜水果取代加工食品，不只注意营养，甚至连每盘菜的颜色和摆盘都非常重视。另外，餐厅里的设计也有了很大的改变，以前的素食餐厅经常是又旧又挤的，墙上还挂着跟佛教有关的画像; 而现在则有很多高级的素食餐厅，看起来干净舒适，墙上挂着诗词，桌边摆着花草，显得特别有禅意和诗意的气氛。这样的素食餐厅其实并不便宜，但是已经成了家人朋友约好一起吃饭聊天的地方，就是为了享受一下这种健康放松的饮食方式。即使你不想花那么多钱在高级餐厅吃素食，路边也有许多素食小吃，在便利商店也能买到素食产品，连在网路上都能轻轻松松地叫素食外卖。可见，不管饮食习惯怎么变，＂民以食为天＂的文化还是一点都没变。

从老百姓饮食态度的改变，到素食餐厅的变化，我们可以看到素食已成了台湾饮食文化中特别的"风景"。"吃素"已经不完全是传统习俗里"吃斋"的意思，而是一种新的饮食习惯和生活态度。要是你有机会到台湾玩，千万别忘了亲身体验这个"素食天堂"的活力与特色!

Appendix C

Screenshot of the student blog post



Gamification in American High School Students' Chinese Learning: A Case Study of Using Speed Mandarin (汉语学习的游戏化：用 Speed Mandarin 教美国高中生汉语的案例研究)

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Abstract: The purpose of this study was to investigate the effectiveness of using gamification in the form of the Speed Mandarin computer program to facilitate American high school students' learning of Chinese as a foreign language. Paired sampling was used with a total number of 60 students in an urban high school setting. Students in the experimental group used Speed Mandarin throughout a 16-week academic semester. Pre- and post-treatment questionnaires were used to examine students' beliefs about their abilities to read Chinese, understand spoken Chinese, speak Chinese, acquire new Chinese vocabulary, and use a variety of learning strategies to master Chinese. Data were also gathered about their level of motivation to learn Chinese. Data analysis via one-way ANOVA with the experimental condition as the between-group measure showed significance for the effect of Speed Mandarin on students' belief in their ability to speak Chinese, but showed no significant effects on reading, listening, or vocabulary acquisition. Nor was there any significant difference in language learning strategies or motivation for learning Chinese. Suggestions are provided for potential use of Speed Mandarin in high school Chinese classes as well as for further research. Further research is needed in order to investigate possible relationships between the use of Speed Mandarin and increases in student confidence in other areas of language learning, as well as increases in actual student performance.

摘要：这项研究的目的是调查使用 Speed Mandarin 计算机程序游戏以促进美国高中生学习汉语的有效性。某市区高中共有 60 名学生参加了配对抽样。实验组的学生在整个 16 周的学期中都使用 Speed Mandarin。用实施前后的问卷来检验学生对他们掌握汉语能力的信念（汉语阅读、听力理解、汉语会话、和词汇学习）以及使用各种学习策略来精通汉语。还收集了有关他们学习汉语的动机水平的数据。通过单因素方差分析以实验条件作为组间度量进行的数据分析显示，学习策略和 Speed Mandarin 对学生汉语会话能力的影响具有显著性，但

对汉语阅读，听力理解或词汇学习没有显著影响，对汉语学习策略或学习动机也没有显著影响。我们探讨在普通高中汉语课程中如何使用 Speed Mandarin 研究提出建议。至于使用 Speed Mandarin 与学生在其他语言学习领域的信心增强，并对后续学生实际成绩提高之间的可能关系，也需要进一步的调查研究。

Keywords: Gamification, Mandarin Chinese, educational technology, foreign language education, perceived competence

关键词：游戏化、汉语普通话、教育技术、外语教育、能力信念

1. Introduction

According to the 2017 national statistics on the study of foreign languages, Chinese is fourth in popularity in the USA, behind Spanish, French, and German (in that order). The National K-12 Foreign Language Enrollment Survey Report shows that 9.7 million K-12 U.S. students are studying a major (second) language. Among them, approximately 227,000 students have enrolled in Chinese language courses, falling behind 7.36 million in Spanish courses, 1.29 million in French, and almost 331,000 in German (American Councils for International Education, 2017, p. 8). Regarding the distribution of high school students enrolled in Less Commonly Taught Languages (LCTL) among various states,

> The explosion of Chinese enrollment and in the number of high school LCTL programs offering Chinese is a dominant feature in the landscape of LCTL education in the U.S. Enrollment in Chinese classes has grown to the largest proportion of all students enrolled in Flagship languages (Arabic, Chinese, Hindi/Urdu, Korean, Persian, Portuguese, Russian, Swahili, and Turkish), accounting for 80% of total number of high school students enrolled in these languages in the U.S. (American Councils for International Education, 2017, p.18).

However, major differences between the structure of English and Chinese make Chinese much more difficult for many Western learners than Spanish, French, or German. English (and many other Western languages) use discrete alphabets to construct words that are then combined grammatically into sentences. Chinese characters are not constructed from an alphabet; they may be pictographs, simple ideograms, combined ideographs, or semantic-phonetic compounds (Linge, 2018). To make matters more complex, Chinese is a tonal language (whereas English is not). In other words, a change in pronounced tone can change the meaning of a spoken Chinese word (sometimes in dramatic ways), while tone in English does not convey information about the meaning of the word being pronounced (Grasu, 2015). Along with the widespread adoption of technologies in American life, this has caused educators and researchers to pay more attention to the potential of technology in teaching and learning Chinese. Students are now eager to use different technologies, and they are skilled and interested in these technologies (Prensky, 2001).

In this study, we examine the use of Speed Mandarin,[1] a mobile Chinese learning game app, in learning of Chinese. More specifically, we explore whether using Speed Mandarin can support Chinese learning among native English speakers in high school and provide some suggestions to assist educators in better using Speed Mandarin in high school Chinese classes. Speed Mandarin is chosen because one of the co-authors of this study had prior experience in using Speed Mandarin with high school students.

2. Review of Literature

Gamification as a term originated in the digital media industry. The first documented use dates back to 2008, but the term only entered widespread adoption in the second half of 2010 (Deterding, Dixon, Khaled, & Nacke, 2011). Zichermann and Cunningham (2011) defined gamification as the "use of game based thinking and game-related functions to help users solve problems and to draw their interest." It is easy to confuse gamification with game-based learning. In practice it is a matter of emphasis, and there is potential overlap between the two categories. Gamification has learning as its primary goal, and employs game play as a means to that end. Game-based learning has the playing of a game as its primary goal, with a secondary function of learning. One might think of this as a continuum, with a grey area in the middle where learning and game play share an equal level of emphasis. For example, Duolingo[2] is a free popular language-learning website and Smartphone app for learning foreign languages. Its main purpose is education, but it provides instruction and practice in a game format that makes the lessons more motivational. It is a clear example of gamification. For a clear example of game-based learning, imagine a game that students have played for recreational purposes for years—something like Monopoly.[3] Then consider a foreign language version of that same game. It is still primarily a game that could be played for fun. But some foreign language acquisition would creep into the game-playing process. What about the area of overlap? It is not at all clear which category to use if a foreign-language teacher brings foreign-language Monopoly into the classroom with substantial educational goals. The best way to think about it is probably to put it into both categories simultaneously.

Hunicke, LeBlanc, and Zubek (2004) created a formal scheme (the MDA framework) for analyzing the use of games. It formalizes the consumption of games by breaking them into their distinct components (rules, system, and fun) and establishing their design counterparts—the MDA framework (mechanics, dynamics and aesthetics). Game mechanics (or game dynamics) are an important part of gamification. These two terms are closely related and sometimes used interchangeably (Bunchball, 2010). Game mechanics are the various actions, behaviors, and control mechanisms that are used to "gamify" an activity, such as points, levels and challenges. Game dynamics are the results of motivations, which include reward, status, achievement, etc. (Bunchball, 2010). Game

[1] See https://www.speedmandarin.org
[2] See https://www.duolingo.com
[3] See https://monopoly.hasbro.com

aesthetics defines the desirable emotional responses evoked in the player, when he or she interacts with the game system (Hunicke, LeBlanc, & Zubek, 2004).

The purpose of applying gamification in teaching and learning Chinese is to motivate learners. Lee and Hammer (2011) stated that one of the central problems of high school students in the U.S. is lack of self-motivation and the increasing number of drop-outs. Motivation includes two parts: intrinsic motivation and extrinsic motivation. Intrinsic motivation refers to behavior that is driven by internal rewards. In other words, the motivation to engage in a behavior arises from within the individual because it is naturally satisfying to you. This contrasts with extrinsic motivation, which involves engaging in a behavior in order to earn external rewards or avoid punishment (Cherry, 2019). The primary responsibility for learning lies with the student; the teacher is present to assist. One form that assistance takes is for the teacher to help students engage with the content and find robust sources of motivation—presumably both intrinsic and extrinsic.

Technology in education and gamification in particular are often (but not always) motivational. With the growing popularity of both, a variety of software has come into being that seeks to harness the potential of gamification for foreign language learning. Some are general-purpose language learning programs that can be used for a variety of different languages. Examples of these include Duolingo and Mondly.[4] Some are created specifically for a single language. In the case of Chinese, one could cite both Speed Mandarin and Lingo Bus[5] as examples. The authors of this study chose to investigate the use of Speed Mandarin in an American high school setting. The program provides illustrations to link each Chinese character visually to its meaning and also provides a rhyme with mnemonic value. For example, māo [cat, 猫 (simplified)/ 貓 (traditional)] catches mouse, in which the rhyme between "mao" and "mouse" provides mnemonic value. It includes monitoring functions that teachers can use to record students' learning. Since it is available for Android, iOS, and on the web (and since every student at the high school where this study was conducted is equipped with a Chromebook and a mobile phone), access was not a problem.

3. Rationale and Research Questions

Major differences between English and Chinese make Chinese difficult for many Western learners. English is phonetic. It uses words spelled out in a Western alphabet, and the meaning of English words remains constant regardless of the tones used to pronounce the word. This means that one must learn only two things to learn a new English word: its spelling and its meaning. Chinese represents words with unique characters rather than spelling them with an alphabet, and it also employs pronunciation and tone to indicate changes in meaning. Chinese is a tonal language. For example, when someone says "tang" they could mean soup (tāng 汤/湯), sugar (táng 糖/糖), lie down (tǎng 躺/躺), or hot (tàng 烫/燙). This means that one must learn four things when learning a new word in Chinese: the shape of its unique character, its pronunciation, the tone(s) associated with its

[4] See https://www.mondly.com
[5] See https://www.lingobus.com

pronunciation, and its meaning(s). The Chinese language is immensely different from English. An English speaker must make the leap from viewing a cryptic-looking symbol (or set of symbols) that is *not* a "spelling" of a word to recognizing its meaning, pronunciation, and tone(s). The symbols do not contain hints about the pronunciation or tones in the way that English spelling does; there is no "phonetic" approach to sounding out a Chinese word. For this reason, Chinese teachers use a great deal of synchronous drill and practice. They say "Here is a Chinese character; here is the meaning, the pronunciation and the tone. Now memorize it." Many American students find this extremely difficult and frustrating, and they look for some way of representing Chinese words visually in a way that would convey information about pronunciation and tone. Best practice in foreign language education generally discourages this type of approach (i.e. using one's native language to spell out the foreign language), but such a system does exist in the form of pinyin. But there is a strong tendency for English speakers to misinterpret pinyin. Pinyin uses Western letters and diacritical marks to spell out the pronunciation of Chinese words, but there are two problems. The most critical one is that while the diacritical marks used in pinyin are mostly familiar to English speakers, the *meaning* of those marks is different in pinyin. For example, the pinyin version of the Chinese word for soup is tāng 汤/湯. To an English speaker, this would normally indicate a long "a" (as in "table"). However, in pinyin, this diacritical mark indicates a flat tone rather than a specific vowel pronunciation. In this case, "tāng" should be pronounced using the velar nasal (i.e. rear nasal) sounding like "tung" or "tongue" rather than using the alveolar nasal (i.e. front nasal) as "tang" or "taing." The second problem is that pinyin tends to give English speakers the idea that one can spell Chinese words using a Western alphabet, which is simply not true. Pinyin is a bridge to recognizing Chinese characters rather than an alternative, spelling-based way of writing Chinese words.

One way of avoiding the problems introduced by pinyin is to add gamification techniques to the conventional drill and practice method for learning Chinese characters. Speed Mandarin is one program that takes this approach.

The major purpose of this study was to investigate the effectiveness of using Speed Mandarin to facilitate American high school students learning Chinese as a foreign language. Based on this purpose, the following research questions were addressed:

1. Do students using Speed Mandarin perceive their Chinese language learning (in the areas of reading, listening, speaking, and vocabulary acquisition) to be superior to that of students studying the same content without using Speed Mandarin?
2. Do students using Speed Mandarin perceive themselves as more likely to use a variety of Chinese learning strategies than students studying the same content without using Speed Mandarin?
3. Do students using Speed Mandarin perceive themselves as more highly motivated to learn Chinese than students studying the same content without using Speed Mandarin?

Our hypothesis is that students using Speed Mandarin will perceive themselves in a more positive light on all of these factors than their classmates studying the same content without Speed Mandarin.

4. Method

4.1 Research Design

The purpose of the study is to explore the effects of using Speed Mandarin on American high school students' perceptions about different aspects of learning Chinese. Pre- and post-surveys were administered to all students in the control and experimental groups at the beginning and end of one academic semester. The pre-surveys were used to collect demographic information, and the post-surveys were used to collect data on students' perspectives on their Chinese language learning competencies (in the areas of reading, listening, speaking, and vocabulary acquisition), usage of Chinese learning strategies, and motivation for learning Chinese. During the semester, the experimental group made regular use of Speed Mandarin, and the control group used conventional drill-and-practice learning activities in their Chinese class.

4.2 Sample

All the participants in this study were enrolled in a Chinese as a foreign language program at a Midwestern urban high school in the U.S. The Chinese classes met daily and lasted 30 minutes. The study consists of 60 participants (female=32, male=28). Fifty-four were classified as Chinese Level 1 ("novice low" on the ACTFL scale; American Council on the Teaching of Foreign Languages, 2012), and six were classified as Chinese Level 2 ("intermediate low" on the ACTFL scale). Twenty-four were in eighth grade, fifteen were in ninth grade, sixteen were in tenth grade, and five were in eleventh grade. The average age is 16, with a range from 15-17 years old. The participants were mostly ethnic minorities, including fifty-five African-American, two Asian American (Filipino), and three Caucasian (White). All participants reported that English was their native language and their primary language spoken at home. An experienced Chinese teacher skilled in the use of Speed Mandarin taught all the participants. Fifty-two participants indicated that they studied Chinese for approximately five hours a week, while eight of them reported longer Chinese study time that ranged from six to nine hours.

4.3 Instruments

This study used a questionnaire (see Appendix A) to collect data before and after the treatment period. The pre-survey questionnaire contained general demographic questions not included in the post-survey version. Otherwise, the two were identical and contained scales for "confidence in ability to learn Chinese," "language learning strategies," and "beliefs about Chinese learning."

Demographic information comprised student's grade level, age, gender, level of Chinese study, ethnicity, native language, primary language spoken in the home, and the student's estimate of weekly time spent studying Chinese.

The scale for "confidence in ability to learn Chinese" contained a total of 20 questions divided evenly among four areas of competency: reading, listening, speaking, and vocabulary. It was adapted from an instrument developed by the National Foreign Language Resource Center (2000). For this scale, students are asked to rate their confidence in their own ability to complete a specified Chinese language learning task, such as figuring out a phrase they do not understand. Students may rate their confidence from 0 (not sure at all) to 100 (completely sure).

The scale for "language learning strategies" contained 28 questions and used a five-point Likert scale, where 1 represents "never or almost never true" and 5 "always or almost always true." This scale came from Ardasheva and Tretter (2013) and was based on an original scale developed by Oxford (1990). For this scale, students were asked to rate how frequently they used specified strategies as part of their Chinese language learning process, such as looking for words in Chinese that sound like words in their native language.

The scale for "beliefs about Chinese learning" contained 17 items and also used a five-point Likert scale, where 1 represents "strongly disagree" and 5 "strongly agree." This scale was a shortened version of an instrument developed by Lan (2014) to measure student beliefs about Chinese learning. Students were asked to rate the extent to which they agreed or disagreed with specific statements about their motivation to learn Chinese, such as having personal plans to continue studying Chinese.

One should note that for both the "language learning strategies" scale and the "beliefs about Chinese learning" scale, a five-point Likert scale was used rather than the more common seven- or nine-point scale. This decision was made to reduce potential confusion on the part of the student. Dawes (2002) has found very little difference between these scale formats in terms of variation about the skewness, mean, and kurtosis. A Likert scale was chosen to allow the uncovering of degrees of opinion on the part of the students in the study.

4.4 Procedure

Student participants were recruited from a Midwestern urban high school in the U.S. One of the researchers who is familiar with the Speed Mandarin gamification application was teaching Mandarin at this high school. Prior to the beginning of the study, the researchers obtained support and permission from the administration to conduct the study in all Mandarin classes taught by this teacher. Parental consent forms were then collected from all participating students. The students were randomly assigned to the control and the experimental groups, each consisting of 30 students. Students in the experimental group were taught how to use Speed Mandarin on their mobile devices to learn new Chinese characters. Students in the control group used the traditional method (i.e., vocal drill and repetition) to learn the same set of characters. Both groups met daily for Mandarin lessons and spent the same amount of time (30 minutes) on each session. The thirty minutes of daily practice time (using Speed Mandarin or traditional methods) took place during Chinese class at school. The experiment continued for one semester. All subjects completed pre- and post-survey questionnaires administered by the Chinese language teacher.

4.5 Data Analysis

Data analysis was conducted in three steps. First, we examined gender differences in the students' Chinese competencies, language learning strategies, and motivation for learning Chinese by conducting one-way analysis of variance with gender as the between group measure. Second, we explored the relationships among these learning outcomes by conducting bivariate Pearson correlation analysis. Third, we tested our hypothesis regarding the effect of the intervention on these learning outcomes by conducting one-way analysis of variance with the experimental condition as the between group measure. As one would expect, the first two steps were preliminary and were not intended to test our hypothesis or to answer our research questions for the study. Only the third step was to test our hypothesis for the study.

Table 1 presents descriptive statistics (means and standard deviations) of outcome variables for female and male students, and inferential statistics (F-values and p-values) in the analysis of variance between the two groups on each outcome variable. The outcome variables include four perceived Chinese language learning competency variables in the four aspects of Chinese language learning (i.e., reading comprehension, listening comprehension, spoken communication, and vocabulary acquisition), one variable on Chinese language learning strategies, and one variable on motivation for Chinese language learning. Descriptive statistics on these variables were fairly commensurate between the two groups. Inferential statistics show no significant differences between female and male students on any of the outcome variables. This indicates that students of both genders reported similar perceived levels of their Chinese language competencies in all four areas (reading, listening, speaking, and vocabulary), similar frequency of using language learning strategies, and similar level of motivation for learning Chinese as a foreign language. The data in Tables 1, 2, and 3 represents post-surveys results only.

Table 1 Gender Differences in Chinese Competencies, Language Learning Strategies, and Motivation for Learning Chinese

Variables	Female (n=32)		Male (n=28)			
	M	SD	M	SD	*F*	*p*
Reading Competency	3.46	.23	3.46	.27	.007	.934
Listening Competency	3.50	.33	3.38	.37	1.807	.184
Speaking Competency	3.60	.35	3.50	.36	1.196	.279
Vocabulary Competency	3.39	.27	3.44	.37	.256	.615
Learning Strategies	3.54	.16	3.54	.20	.036	.850
Motivation	3.50	.19	3.46	.16	.858	.358

Table 2 indicates the correlation coefficients among the outcome variables. Chinese reading competency was significantly correlated to Chinese speaking competency ($r = .54$, $p < .01$) and Chinese vocabulary competency ($r = .72$, $p < .01$). Chinese listening competency was not correlated to any of the other three competencies. The extent students used language learning strategies was not related to their motivation for learning Chinese.

Neither student use of language learning strategies nor student motivation for learning Chinese was related to any of the four Chinese language competencies.

Table 2 Correlation Coefficients among Chinese Competencies, Language Learning Strategies, and Motivation for Learning Chinese

	1	2	3	4	5	6
1. Reading Competency	––					
2. Listening Competency	.21	––				
3. Speaking Competency	**.54****	.15	––			
4. Vocabulary Competency	**.72****	.20	.17	––		
5. Learning Strategies	-.03	-.06	.12	-.01	––	
6. Motivation	-.06	.07	-.19	.08	.11	––

Note. ** p <.01.

Table 3 shows descriptive statistics (means and standard deviations) of outcome variables for the control and experimental groups, and inferential statistics (F-value and p-value) in the analysis of variance between the two groups on each outcome variable. Means on these variables were largely comparable between the two groups except for two variables—Chinese listening competency (3.37 vs. 3.51) and Chinese speaking competency (3.46 vs. 3.65). Inferential analysis finds only significant difference in Chinese speaking competency, $F(1, 58) = 4.415$, $p = .04$. The experimental group reported higher level of Chinese speaking competency than the control group did. There was no significant difference in the other three competencies. Nor was there any significant difference in language learning strategies or motivation for learning Chinese.

The data below show that the only significant result was that students in the experimental group (i.e. those who used Speed Mandarin) were significantly more likely that students in the control group to perceive themselves as competent is speaking Mandarin Chinese.

Table 3 Comparison of Control and Experimental Groups in Chinese Competencies, Language Learning Strategies, and Motivation for Learning Chinese

Variables	Control (n=30)		Experimental (n=30)			
	M	SD	M	SD	*F*	*p*
Reading Competency	3.48	.22	3.44	.27	.395	.532
Listening Competency	3.37	.34	3.51	.36	2.438	.124
Speaking Competency	**3.46***	.34	**3.65***	.35	4.415	**.040**
Vocabulary Competency	3.43	.30	3.40	.34	.103	.749
Learning Strategies	3.55	.18	3.54	.19	.041	.840
Motivation	3.47	.21	3.49	.14	.117	.733

Note. * p <.05.

5. Results

We found no significant gender differences in any of the measures. The results of our data analysis provide partial support for our hypothesis. Students who studied Chinese in a classroom using the gamification Speed Mandarin perceived a higher level of competency than those who were not exposed to the use of this application in one area of Chinese language learning (speaking) but not in the other three competencies, in learning strategies, or in motivation. It is possible that this finding can be attributed to the intentionally playful and bold ways that the actors pronounced Chinese words and phrases in the video-gamification based components of the application.

6. Discussion

We were able to find support for the hypothesis that the use of Speed Mandarin would significantly increase students' belief in their own ability to speak Chinese, as compared to their classmates who were not using Speed Mandarin during the same time period. This is a modest but positive result; confidence in one's ability to succeed is a very real contributor to success. We were unable to find definitive support for the hypothesis that the use of Speed Mandarin would also increase students' belief in their ability to read, to listen to Chinese, to acquire new Chinese vocabulary, or in their motivation to learn Chinese. It is possible that learning motivation and/or learning strategies might be better addressed through incorporating Speed Mandarin (or other similar apps or programs) differently into the Chinese teaching/learning process. In this study the program was used simply for regular practice. If one component of the learning process required students to implement different learning strategies in combination with regular use of the program, or if student formative evaluation was monitored during the course of program usage and students received regular performance updates that could reflect any immediate impact on their Chinese learning, it is possible that significant results would be present. Both of those are promising areas for future research.

Innovative learning approaches and applications like gamification are increasingly mentioned in related literature. Experimental studies examining the effects of these applications, which are quite new to the literature, on the education process are few in number. But most of these studies demonstrate that these learning approaches can meet 21st century students' needs and demands and provide innovative solutions to current pedagogical problem (Deterding et al., 2011; Zichermann & Cunningham, 2011; Sarıtaş, Yildiz, & Şenel, 2015).

7. Suggestions and Limitations

Based on our findings, we tentatively recommend the use of programs like Speed Mandarin in teaching Chinese for the purpose of increasing students' confidence in their own ability to speak a difficult language successfully. This study had a number of limitations, and conducting additional research that addresses these limitations might well provide more definitive conclusions. Most notably, the research design is missing measures of actual student performance as opposed to student perceptions of performance; adding

objective outcome measures would significantly strengthen the design. Enlarging the sample size from the relatively small number of 60 would also be helpful, as would including a representative sample from a variety of different schools.

8. Conclusions

This study provides a preliminary examination of using gamification (in the form of the Speed Mandarin program) as a tool in Chinese learning for urban high school students. The use of Speed Mandarin was found to significantly improve students' confidence in their own ability to speak Chinese, though no significant effects were found on students' confidence in their abilities to read Chinese, understand spoken Chinese, acquire new Chinese vocabulary, or use a variety of learning strategies, or on their motivation to learn Chinese. Since self-confidence plays an important role in language learning, gamification in the form of Speed Mandarin appears useful in at least one area of Chinese language instruction – that of learning to speak the language aloud. Further research is needed in order to investigate possible relationships between the use of Speed Mandarin and increases in student confidence in other areas of language learning, as well as increases in actual student performance.

Further research is needed with a more robust experimental design and a larger sample size. In the interim, we found positive (and no negative) outcomes associated with the use of Speed Mandarin, and feel comfortable recommending its use in the teaching and learning of Chinese.

References

American Councils for International Education. (2017). The national k-12 foreign language enrollment survey report. Retrieved from https://www.americancouncils.org/sites/default/files/FLE-report-June17.pdf

American Council on the Teaching of Foreign Languages. (2012). ACTFL proficiency guidelines 2012. Retrieved from https://www.actfl.org/publications/guidelines-and-manuals/actfl-proficiency-guidelines-2012

Ardasheva, Y., & Tretter, T. R. (2013). Strategy inventory for language learning–ELL student form: Testing for factorial validity. *The Modern Language Journal, 97*(2), 474-489.

Bunchball. (2010). Gamification 101: An introduction to the use of game dynamics to influence behavior. Retrieved from https://www.bunchball.com/gamification101

Cherry, K. (2019). Intrinsic motivation: Why you do things? Retrieved from https://www.verywellmind.com/what-is-intrinsic-motivation-2795385

Dawes, J. (2002). Five point vs. eleven point scales: Does it make a difference to data characteristics? *Australasian Journal of Market Research, 10*(1), 39–47.

Deterding, S., Dixon, D., Khaled, R., & Nacke, L. (2011). From game design elements to gamefulness: Defining "gamification." In A. Lugmayr, H. Franssila, C. Safran, & I. Hammouda (Eds.), *Proceedings of the 15th international academic MindTrek*

conference: Envisioning future media environments (pp. 9-15). New York, NY: Association for Computing Machinery (ACM).

Grasu, D. (2015). Tonal vs. non-tonal languages: Chinese vs. English. Retrieved from https://www.lexington.ro/en/blog/item/29-tonal-vs-non-tonal-languages-chinese-vs-english.html

Hunicke, R., LeBlanc, M., & Zubek, R. (2004). MDA: A formal approach to game design and game research. Retrieved from http://www.cs.northwestern.edu/~hunicke/MDA.pdf

Lan, Y. J. (2014). Does Second Life improve Mandarin learning by overseas Chinese students? *Language Learning & Technology, 18*(2), 36–56.

Lee, J. J., & Hammer, J. (2011). Gamification in education: What, how, why bother? *Academic Exchange Quarterly, 15*(2), 1-5.

Linge, O. (2018). Chinese language characters as pictographs. Retrieved from https://www.thoughtco.com/chinese-characters-pictographs-2278395

National Foreign Language Resource Center. (2000). *High school foreign language students' perceptions of language learning strategies use and self-efficacy.* Washington, D.C.: Department of Education. (ERIC Document Reproduction Service No. ED 445 517.)

Oxford, R. L. (1990). *Language learning strategies: What every teacher should know*. Boston: Heinle & Heinle.

Prensky, M. (2001). Digital natives, digital immigrants (part 1). *On the Horizon, 9*(5), 1–6.

Sarıtaş, M. T., Yıldız, E., & Şenel, H. C. (2015). Examining the attitudes and intention to use synchronous distance learning technology among pre-service teachers: A qualitative perspective of technology acceptance model. *American Journal of Educational Research, 3*(10A), 17-25.

Zichermann, G., & Cunningham, C. (2011). *Gamification by design: Implementing game mechanics in web and mobile apps.* Sebastopol, CA: O'Reilly Media, Inc.

Appendix A

Questionnaire for Learners of Chinese as a Second Language

Section I: Confidence in Ability to Learn Chinese

****

Directions: How confident are you about learning and using Chinese? Reading, listening, and speaking are activities you do to learn and use Chinese. This questionnaire describes different kinds of tasks you might do in Chinese. For each kind of task, you are going to rate how sure you are that you could work on a language task *like the one described* and do what you are supposed to do in a reasonable amount of time.

The rating scale goes from 0 to 100. Marking a higher number means you are more sure that you could do the activity, while marking a lower number means you are less sure that you could do it. Please mark how you *really* feel about your capability to do a language task like the one described. **There are no right or wrong answers. There are only answers that tell how you actually feel.**

****

Reading Chinese: Reading is a frequent activity you use for learning and using Chinese. You may often read texts such as dialogues, stories, and advertisements in Chinese as part of classwork or on your own. Please **circle the number** on the line at the right that shows how sure you are that you could read a text in Chinese and...	
R1 ....figure out the main topic or gist.	**0**------10------20------30------40------**50**------60------70------80------90------**100** Not Sure — Somewhat unsure — Kind of sure — Very sure — Completely sure
R2 ....answer questions about very specific information.	**0**------10------20------30------40------**50**------60------70------80------90------**100** Not Sure — Somewhat unsure — Kind of sure — Very sure — Completely sure
R3 ....figure out the meanings of words or phrases you don't understand.	**0**------10------20------30------40------**50**------60------70------80------90------**100** Not Sure — Somewhat unsure — Kind of sure — Very sure — Completely sure
R4 ....retell in English what you read.	**0**------10------20------30------40------**50**------60------70------80------90------**100** Not Sure — Somewhat unsure — Kind of sure — Very sure — Completely sure
R5 ....use a Chinese text to accomplish a task in real life (e.g., read a menu to order a meal).	**0**------10------20------30------40------**50**------60------70------80------90------**100** Not Sure — Somewhat unsure — Kind of sure — Very sure — Completely sure

Listening to Chinese: You may often listen to people speaking Chinese--your teacher, classmates, and native speakers (in person, on videotapes, and on cassettes), and you want to make sure you understand them. Please **circle the number** on the line at the right that shows <u>how sure you are</u> that you could listen to Chinese and...	
Ll ....understand the gist of what you hear.	**0**------10------20------30------40------**50**------60------70------80------90------**100** Not Sure / Somewhat unsure / Kind of sure / Very sure / Completely sure
L2 ....understand details.	**0**------10------20------30------40------**50**------60------70------80------90------**100** Not Sure / Somewhat unsure / Kind of sure / Very sure / Completely sure
L3 ....figure out the meanings of words or phrases you don't understand.	**0**------10------20------30------40------**50**------60------70------80------90------**100** Not Sure / Somewhat unsure / Kind of sure / Very sure / Completely sure
L4 ....retell in English what you heard.	**0**------10------20------30------40------**50**------60------70------80------90------**100** Not Sure / Somewhat unsure / Kind of sure / Very sure / Completely sure
L5 ....use the information heard in Chinese to accomplish a task in real life (e.g., understand directions to a train station).	**0**------10------20------30------40------**50**------60------70------80------90------**100** Not Sure / Somewhat unsure / Kind of sure / Very sure / Completely sure
Speaking Chinese: Part of learning and using Chinese is being able to speak it. In class you may have to answer questions, talk to classmates, and give information about yourself. Outside of class you might have conversations with native speakers and friends. Please **circle the number** on the line at the right that shows <u>how sure you are</u> that you could speak Chinese and...	
S1 ....communicate the main point(s) of what you want to say.	**0**------10------20------30------40------**50**------60------70------80------90------**100** Not Sure / Somewhat unsure / Kind of sure / Very sure / Completely sure
S2 ....give supporting details and explanations at a listener's request.	**0**------10------20------30------40------**50**------60------70------80------90------**100** Not Sure / Somewhat unsure / Kind of sure / Very sure / Completely sure
S3 ....solve communication problems when you don't know how to say something or when the listener doesn't understand.	**0**------10------20------30------40------**50**------60------70------80------90------**100** Not Sure / Somewhat unsure / Kind of sure / Very sure / Completely sure

S4 ....know whether the listener is understanding you correctly.	**0**------10------20------30------40------**50**------60------70------80------90------**100** Not Sure — Somewhat unsure — Kind of sure — Very sure — Completely sure
S5 ....accomplish a task in real life (e.g., asking the price of an item in a store).	**0**------10------20------30------40------**50**------60------70------80------90------**100** Not Sure — Somewhat unsure — Kind of sure — Very sure — Completely sure
Learning Vocabulary: Learning new words is a major part of learning Chinese. You may have to learn vocabulary given to you by your teacher. You might also learn words that you want to know. Please **circle the number** on the line at the right that shows <u>how sure you are</u> that you could have a list of Chinese vocabulary words like you have in class and...	
VI ....learn what each word means.	**0**------10------20------30------40------**50**------60------70------80------90------**100** Not Sure — Somewhat unsure — Kind of sure — Very sure — Completely sure
V2 ....use each word correctly in a sentence.	**0**------10------20------30------40------**50**------60------70------80------90------**100** Not Sure — Somewhat unsure — Kind of sure — Very sure — Completely sure
V3 ....hear or read sentences with these words and understand the meaning of the sentences.	**0**------10------20------30------40------**50**------60------70------80------90------**100** Not Sure — Somewhat unsure — Kind of sure — Very sure — Completely sure
V4 ....remember the meaning of each word a month later.	**0**------10------20------30------40------**50**------60------70------80------90------**100** Not Sure — Somewhat unsure — Kind of sure — Very sure — Completely sure
V5 ....understand or use the word in a real life setting.	**0**------10------20------30------40------**50**------60------70------80------90------**100** Not Sure — Somewhat unsure — Kind of sure — Very sure — Completely sure

Note:
This questionnaire was adapted from an instrument developed by the National Foreign Language Resource Center (2000).

Reference:

National Foreign Language Resource Center. (2000). *High school foreign language students' perceptions of language learning strategies use and self-efficacy*. Washington, DC: Department of Education. (ERIC Document Reproduction Service No. ED 445 517.)

Section II: Language Learning Strategies

****

Directions: Below are 28 statements regarding the language learning strategies in language learning. Please read the statements carefully and mark the number from 1 (never or almost never true of me) to 5 (always or almost always true of me) which is most suitable for you. **There are no right or wrong answers. There are only answers that tell how you actually feel.**

****

	Never or almost never true of me	Usually not true of me	Somewhat true of me	Usually true of me	Always or almost always true of me
l. I use flashcards to learn new Chinese words.	1	2	3	4	5
2. I use rhymes to help me learn new Chinese words.	1	2	3	4	5
3. I act out new Chinese words.	1	2	3	4	5
4. I use new Chinese words in a sentence to help me learn them.	1	2	3	4	5
5. I learn new words by thinking about when I can use them.	1	2	3	4	5
6. When I hear a new Chinese word I think of a picture to help me learn the word.	1	2	3	4	5
7. I learn new words by thinking about where I first saw them on the page, on the board, or on a street sign.	1	2	3	4	5
8. I read for fun in Chinese.	1	2	3	4	5
9. I first read a page (a text) quickly and then go back and read it carefully.	1	2	3	4	5
10. I look for words in Chinese that are like my own language.	1	2	3	4	5
11. I break long words into small parts to figure out what they mean.	1	2	3	4	5
12. I make summaries of	1	2	3	4	5

	Never or almost never true of me	Usually not true of me	Somewhat true of me	Usually true of me	Always or almost always true of me
things I hear or read in Chinese.					
13. If I can't think of a Chinese word, I show what I mean with my hands.	1	2	3	4	5
14. I make up a new word if I can't think of a Chinese word.	1	2	3	4	5
15. When I read in Chinese, I don't look up every new word in a dictionary.	1	2	3	4	5
16. I try to guess (predict) what people will say next in Chinese.	1	2	3	4	5
17. If I can't think of a Chinese word, I use a word that means the same thing.	1	2	3	4	5
18. I see my Chinese mistakes and try to do better.	1	2	3	4	5
19. I listen well (carefully) when people speak Chinese.	1	2	3	4	5
20. I look for ways to be a better student of Chinese.	1	2	3	4	5
21. I think about how well I am doing in Chinese.	1	2	3	4	5
22. I give myself a gift or a treat when I do well in Chinese.	1	2	3	4	5
23. I write about how I feel when I am learning Chinese in my journal.	1	2	3	4	5
24. I talk to people about how I feel when I am learning Chinese.	1	2	3	4	5
25. If I don't understand, I ask Chinese speakers to slow down or say it again.	1	2	3	4	5
26. I ask Chinese speakers to correct me when I talk.	1	2	3	4	5
27. I practice Chinese with	1	2	3	4	5

	Never or almost never true of me	Usually not true of me	Somewhat true of me	Usually true of me	Always or almost always true of me
other students.					
28. I ask for help from Chinese speakers.	1	2	3	4	5

Note:
This questionnaire came from Ardasheva and Tretter (2013) and was based on an original scale developed by Oxford (1990).

References:

Ardasheva, Y., & Tretter, T. R. (2013). Strategy inventory for language learning–ELL student form: Testing for factorial validity. *The Modern Language Journal*, 97(2), 474-489.

Oxford, R. L. (1990). *Language learning strategies: What every teacher should know*. Boston: Heinle & Heinle.

Section III: Beliefs about Chinese Learning

****

Directions: The following are a few statements about how you feel about learning Chinese language and culture. Please indicate the extent to which you disagree or agree with each statement using a 5-point scale (1= strongly disagree, 5= strongly agree). Circle the number that best describes you. There is no right or wrong answer.

****

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1. I find great pleasure in learning Chinese.	1	2	3	4	5
2. If I can speak Chinese, I can find more interesting and better jobs.	1	2	3	4	5
3. The language tasks in our Chinese lessons are interesting and helpful.	1	2	3	4	5
4. Learning Chinese broadens my horizons.	1	2	3	4	5
5. Chinese will makes me more competitive in the job market.	1	2	3	4	5
6. I enjoy learning Chinese.	1	2	3	4	5
7. I am interested in Chinese culture, history and/or literature.	1	2	3	4	5
8. My interaction with the teacher in Chinese class is important to me.	1	2	3	4	5
9. I would like to travel to a Chinese-speaking country, such as Taiwan or China.	1	2	3	4	5
10. After I finish this class, I will keep learning Chinese, because studying Chinese is important to me.	1	2	3	4	5
11. Learning Chinese helps me understand Chinese-speaking people and their way of life.	1	2	3	4	5
12. If I can speak Chinese, I can travel more for official purposes.	1	2	3	4	5
13. I think learning Chinese will enable me to get a better education opportunity.	1	2	3	4	5
14. I plan to continue studying Chinese for as long as possible.	1	2	3	4	5
15. I want to use Chinese to work and communicate with Chinese speakers.	1	2	3	4	5

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
16. Learning Chinese makes me feel successful.	1	2	3	4	5
17. Learning Chinese is helpful for my future career.	1	2	3	4	5

Note:
This questionnaire is a shortened version of an instrument developed by Dr. Yu-Ju Lan in 2014. Out of the original 34 items, we selected seventeen items to be included in our questionnaire. The remaining 17 items do not directly measure students' interest in and perceived usefulness/importance of Chinese learning and therefore were excluded.

Reference:
Lan, Y. J. (2014). Does second life improve Mandarin learning by overseas Chinese students? *Language Learning & Technology, 18*(2), 36–56.

Investigating the Effect of Chinese Pronunciation Teaching Materials Using Speech Recognition and Synthesis Functions (利用语音识别及语音合成功能的汉语语音教材的教学效果研究)

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Abstract: Research on teaching pronunciation using computers has finally become prominent in recent Chinese language education in Japan. A more focused method of teaching pronunciation, computer assisted pronunciation teaching (CAPT), which uses speech recognition, has become a subject of research because of its effectiveness. This paper gives an overview of the current state of CAPT in Chinese pronunciation education in Japan and China. It introduces the conception and implementation of the ST Lab (Speech Training Laboratory), an original CAPT teaching platform that uses speech recognition and speech synthesis functions. ST Lab features a teaching material creation interface and thus can be used in conjunction with any textbook or existing learning material. The paper also includes a section that provides preliminary evidence for the ST Lab system's effect on learning in Chinese language class after one and a half years.

摘要：近年来在汉语教育中，一些使用电脑教学的语音教学研究逐渐增加，被称为"CAPT"（电脑辅助语音教学）。其中，利用语音识别功能的语音教学研究尤以其显著效果备受瞩目。本文概述 CAPT 在日本和中国的汉语语音教学之现状，并讨论利用语音识别和语音合成功能开发具有制作语言教材功能的教学系统 ST Lab 之功能。最后以一年半的实际教学状况证实其教学的初步效果。

Keywords: Chinese pronunciation, CAPT, speech recognition, speech synthesis

关键词: 汉语发音、电脑辅助语音教学、语音识别、语音合成

1. Introduction

Modern Chinese language education in Japan has lagged behind English in educational theory, resources, development, and implementation. It was only in the late 1990s that the movement to use computers grew in Chinese language education communities in Japan. According to Tanabe's (2004) work on eLearning, the demand for a transition in Chinese language education "from a structure-centric grammatical syllabus to emphasis on content transfer, and the introduction to meaningful transfer activities through a formalistic focus" gained momentum. As a part of this trend to introduce meaningful transfer activities, the development of autonomous learning systems related to the digitization of textbooks, grammar, and vocabulary has begun**.** However, until recently pronunciation, which is the first major challenge that learners encounter when learning Chinese, was not a subject of study in eLearning systems.

Most Chinese classes at Japanese universities are second language classes for students who are learning Chinese for the first time. The average class time is two classes a week (3 hours), with less than 100 contact hours per year. About ten of these sessions (30 hours) are usually dedicated to the explanation and practice of tones, phonemes, and rhyme; most of them end after an explanation of the four tones and the introduction of about 400 syllables. This is a considerable amount of material to cover in such a period of time. At present, it is difficult to spend enough time for pronunciation practice of two syllable words, which account for 70% of vocabulary frequently used in Chinese. The size of the class is from 30 to 40 students, which is not small. Also, it is hard to say if students have much motivation to study. In such a situation, it is impossible for teachers to repeatedly check each student's pronunciation and to help them correct their pronunciation by asking them to listen until they have the correct grasp of the word sounds, and then repeat practicing until they can pronounce the words correctly. Computers, however, can solve this problem.

One method of teaching using the CALL system is to have students record their own voices. But as Iwai (2015) pointed out, it is difficult for beginners to listen to a model voice and notice their mistakes by themselves. Teachers can also collect recorded audio files, score them, and return them to the learners, giving them appropriate suggestions. However, these classes are usually only twice a week, and feedback a few days after practice is unlikely to be very effective.

As natural language processing and AI technology have developed in recent years, computer technology has finally become a helpful tool in learning Chinese pronunciation. According to Li (2016), the number of studies on the use of speech recognition functions of smartphones and tablets for foreign language education has increased since 2000. There are also other studies that have used methods for visualizing and analyzing speech for pronunciation education, which are called CAPT (computer assisted pronunciation teaching).

In this paper, we discuss previous research of CAPT applications, including cases in which speech recognition was used and another situation in which speech recognition was done using a large-scale Chinese interlanguage speech corpus and deep neural

networks (DNN). After that, we introduce ST Lab, a CAPT system, which is the subject of this current study. After clarifying the difference between this study and previous research, the development concept and functions of the developed pronunciation practice system ST Lab and its initial learning effects are shared.

2. Literature Review

Iwai (2015) mentioned the following advantages of speech recognition software in foreign language acquisition:

1. Immediate feedback on pronunciation in a form that learners can recognize.
2. Immediate feedback helps improve and maintain student's motivation to practice.
3. The learners get motivation from the feedback that occurs right after they pronounce a certain word or phrase. Since they can see the result immediately, even without a teacher's instructions they can keep practicing on a device until it recognizes their pronunciation as correct.

It is important to note that speech recognition did not initially serve educational purposes, but aimed to simplify character input for native speakers. Furui (2000) stated that a computer recognizes not only sounds but other information, such as grammar, vocabulary, and context. There are cases when the latter play an even more significant role than sounds. In other words, even if the pronunciation is not perfect, the speech recognition system can also guess the correct words from context. So, there are cases in which incorrect pronunciation may not cause input failure.

The tendency of computer speech recognition systems to guess words correctly is greater when analyzing them in a sentence using its context rather than recognizing single words with no contextual information provided by a sentence. When a computer speech recognition system is given a single word there is a greater likelihood that the computer will not recognize the word correctly. Also, factors such as microphone performance, voice volume and clarity, enunciation, and surrounding noise may affect the accuracy of the input. When using the speech recognition function, it is necessary to bear in mind that "successful input ≠ correct pronunciation" and "input failure ≠ incorrect pronunciation."

There are several studies on language acquisition using speech recognition. Schwartz et al. (2009) researched English education and mistakes in English pronunciation. Hayashi, Mizuochi, Kiryu, and Kanzaki (2012) investigated the reading out loud of translated content by using a voice recognition system. Iwai (2013) studied the automatic conversion of speech into text by using speech recognition. Finally, Zhao, Tomita, Konno, Ohkawa, and Mitsuishi (2019) developed an application, KoToToMo, for Chinese language acquisition.

KoToToMo is a comprehensive review application based on the beginners textbook *KOTOTOMO: Words as Friends* written by Zhao et al. (2019), and includes writing tasks

by rearranging words.[1] In terms of pronunciation, each section offers practice exercises using the voice synthesis and word learning functions of the online learning tool Quizlet, followed by repeating and shadowing using the recording function. Finally, there is a "trial" using the voice recognition function. The speech recognition task screen displays a button with a pronunciation example, also with pinyin (the Romanization of Chinese characters). That way, the learner can listen to the model voice and repeat it. To increase learner motivation, a character, "Teacher Panda," appears on the screen, cheering the learner if the input is correct. After this, the screen switches to the next task. In case of incorrect input, the "failure" screen appears, Teacher Panda expresses regret, and the screen returns to the same task again, offering learners the opportunity to redo it. It is reported that the learning effectiveness is remarkable.

A study of language education using a large-scale Chinese inter-language speech corpus and DNN speech recognition system looked at 尔雅中文 [Ěryǎ Zhōngwén], an application created by Wei and Zhang in 2018. The application software is based on the textbook series *Ěryǎ* [尔雅]. It provides reading practice for each new word, example sentences, and conversation reading practice. It visualizes pronunciation, dividing it into 3 parts: initial [声母 shēngmǔ], final [韵母 yùnmǔ], and tone [声调 shēngdiào]. It then compares this with the voice of a native speaker and calculates the difference between each part. If the difference is substantial, it indicates that the pronunciation is incorrect, changes the color of the corresponding part of the pinyin displayed on the screen, and shows the correct pronunciation as a percentage.

Wei and Zhang (2018) used the application for a six-week experiment in two classes with a total of 36 international students. Consequently, the learners practiced pronunciation 28,101 times in total and an average of 780.6 times per person. The application was used 8.1% of the time during class hours and 91.1% of the time during extracurricular hours. The number of exercises on the day the teacher asked students to practice pronunciation as homework has increased significantly. Regarding the effectiveness of the application's pronunciation correction, 83.2% of the corrections were improved, showing a remarkable effect.

Both CAPT methods mentioned above have tried to improve pronunciation by giving feedback quickly, and positive results have been achieved. It has been confirmed that many learners practice pronunciation outside of class. This makes such exercises excellent teaching materials for pronunciation education when there is a shortage of study time and the need to undertake extracurricular study.

In August 2012, a report of the Central Education Council, published by the Japanese Ministry of Education, Culture, Sports, Science, and Technology, proposed the following new educational reforms to be pursued:

It is necessary to shift from conventional classes centered on the

[1] Zhao, Zhang, Ueno, Konno, and Mitsuishi (2018) also described the design principles of KoToToMo, namely how to conduct a blended learning class using this teaching material.

> transfer and injection of knowledge to autonomous learning (active learning) where teachers and students communicate, work hard together, and develop intellectually while stimulating each other, and students proactively discover problems and find solutions.[2]

The authors of this paper believe that "active learning" is the direction that CAPTs using Information and Communication Technology (ICT) should take, and that blended learning, which combines CAPTs and face-to-face classes, is a form of education that should be pursued now.

Blended learning is a new form of education in which eLearning and face-to-face teaching are designed to overcome the shortcomings of both. Not only by simply providing students with Internet-enabled educational materials, computers, tablets, and other equipment and the Internet environment. Teachers can understand and use ICT equipment to motivate and keep students engaged as well as to facilitate communication between students and teachers.

The simplicity of sharing and editing teaching materials is also a major advantage of ICT utilization. Even if the same teaching materials are used, there are many cases in which the practice questions prepared by other teachers cannot be used as they are. However, ICT technology makes it much easier to create, edit, and share teaching materials. Therefore, in this research we developed a system, Speech Training Laboratory (ST Lab)[3] that combines a teaching material creation function and a pronunciation practice function by using speech recognition technology and speech synthesis technology. Subsequently, this study uses ST Lab as blended learning material in the classroom to verify its initial effects.

3. The Development of ST Lab

3.1. The Goal of Pronunciation Education and the Definition of a Correct Answer

The ST Lab developed in this research is a pronunciation training system that specializes in teaching "speaking" and "listening" using the speech recognition and speech synthesis functions provided by the Web Speech API (application programming interface). In addition to teaching pronunciation, it also can create, edit, and manage teaching materials, which makes it significantly different from other CAPT applications.

[2] Ministry of Education, Culture, Sports, Science and Technology, Central Council for Education, (2012). "Toward a qualitative transformation of university education to build a new future: To be a university that empowers students to pursue life-long learning and the ability to think independently" (Report) p. 9. [文部科学省，中央教育審議会, (2012). 新たな未来を築くための大学教育の質的転換に向けて～生涯学び続け、主体的に考える力を育成する大学へ～（答申），本文，p. 9.]

[3] https://stlab-elearning.jp/#/login/

The Web Speech API that is used in this study was developed in 2012 by the Speech API Community Group under the W3C (FSA) Final Specification (World Wide Web Consortium).[4] The API has two interfaces: a speech synthesis interface and a speech recognition interface. Among other advantages over other software and API, it is free of charge, easy to learn even for beginners in programming, and can be implemented through JavaScript.[5]

ST Lab does not aim for the "correct pronunciation," but for the mastery of "communicational pronunciation." The speech recognition function is developed on the assumption of native speaker input. The correct speech input does not necessarily mean that the pronunciation is "correct," as described above. Still, pronunciation is considered "correct" when it reaches a level where the speaker can communicate with native speakers. In other words, it means that it was sufficiently practical and fulfilled the conditions to set it as a learning goal.

There are three types of training modes that use speech recognition technology: "Reading Aloud Practice," which reads simplified Chinese words and short sentences aloud; "Pinyin Reading Aloud Practice," which reads pinyin aloud, and; "Simulation Interpretation Practice," which inputs Japanese instructions in Chinese.[6] These voice-recognition trainers also have "help" buttons, which allow learners to hear the voice of Chinese texts throught text-to-speech technology. ST Lab is also equipped with a four-choice listening task that uses the speech synthesis function to learn the four tones [四声 (sìshēng], an aspect of learning to speak Chinese that is challenging to master.

It is preferable to listen to a native speaker's correct example repeatedly to master the correct pronunciation. However, outside of Chinese-speaking regions, recording voices by native speakers and making audio teaching materials through editing is a task that requires enormous effort, time, and money. That audio materials could not be created without this hard work may have been a factor preventing the spread of CAPT. Therefore, text-to-speech technology is used for all speech in ST Lab. Hence, it is able to create and edit audio teaching materials as efficiently as editing texts. Consequently, an environment where anyone can create audio teaching materials easily and quickly has been created.

Some may question the accuracy and acceptability of using synthetic speech for language education rather than an actual native speaker. But speech synthesis technology has already become widespread enough to be used in many everyday situations, and is widely used as a highly efficient technology. Moreover, Sunaoka and Iwami (2009), who

[4] MDN web documents: "Web Speech API". https:// developer.mozilla.org/en-US/docs/Web/ API/ Web Speech API.

[5] ST Lab currently can run speech recognition and speech synthesis function in 16 languages: Chinese (simplified and traditional), Cantonese (Hong Kong), German, Spanish, French, Italian, Korean, Dutch, Polish, Portuguese (Brazil), Indonesian, Hindi, Japan, British English, American English. It is also available to create teaching materials for these languages and to practice pronunciation.

[6] Japanese is used because it is a class for Japanese students. It can be changed to any language that allows text input.

analyzed the degree of acceptance of learners to speech synthesis, argued that learners do not feel uncomfortable with synthesized speech. However, some learners complained that the pitch of synthesized speech was too high or too fast. To resolve user dissatisfaction, a new function, the "Synthetic Voice Adjustment Menu," has been included in all training interfaces for learners. Therefore, users are now able to adjust freely "volume," "pitch," and "rate" of synthesized speech. Users can also choose between male and female voices, depending on their device's operating system.

This system also considers the popularization of pronunciation education using speech recognition. Therefore, ST Lab is designed for compatibility across different device operating systems. It can run on MAC OS and Windows, and on mobile devices using Android, iPad OS, or iOS systems so that it can be used on any PC, tablet, or smartphone.

A prototype of ST Lab was completed in March 2018, and in April it became included in Chinese language study material for first-year students at Okinawa University. It has been used every week for a year and a half. The service, which was released to the public in August, 2019, is already used by 18 universities and high schools in Japan, totaling more than 300 learners.[7]

3.2 Training Menu of ST Lab

3.2.1 Reading Aloud Practice

"Reading Aloud Practice" is an exercise for reading questions written in simplified Chinese. There is also a function to read aloud the question using synthetic speech (see Figure 1, #5). The meaning can be displayed as a supplementary function (see Figure 1, #3). There is no time limit for responses, and the learner can repeat the question as many times as desired until the correct answer is given. If providing the correct answer is too difficult, a skip button (see Figure 1, #9) can be used to skip over the problem. When the synthesized voice adjustment button is pressed the adjustment menu appears (see Figure 2), and the

[7] The ST Lab currently in operation previously had a beta version and a prototype. The prototype was upgraded to a beta version in October 2018, which became the current version in August 2019. The current four practice modes have been in ST Lab from the beginning. But there were also three other menus. For details on previous versions, see Watanabe et al. (2019) and Watanabe et al. (2018).

student can adjust the volume, pitch, and speed of the synthesized voice in any exercise.

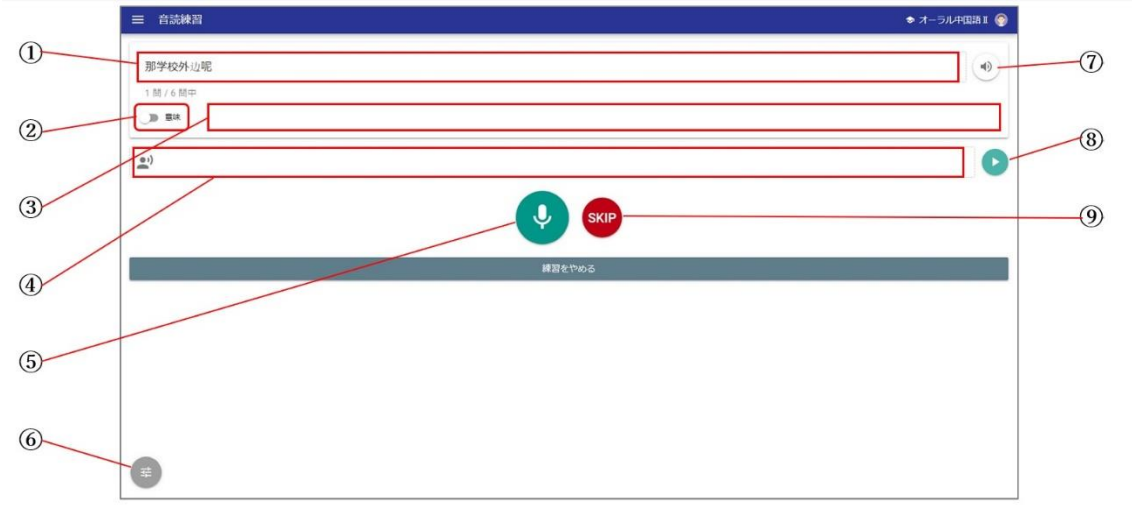

Figure 1 Reading Aloud Practice screen

① Question
② Switch to display meaning
③ Meaning
④ Speech recognition result
⑤ Speech recognition button
⑥ Synthetic voice adjustment menu display button
⑦ Synthetic voice of question
⑧ Synthetic voice of incorrect answer
⑨ Button to skip the question

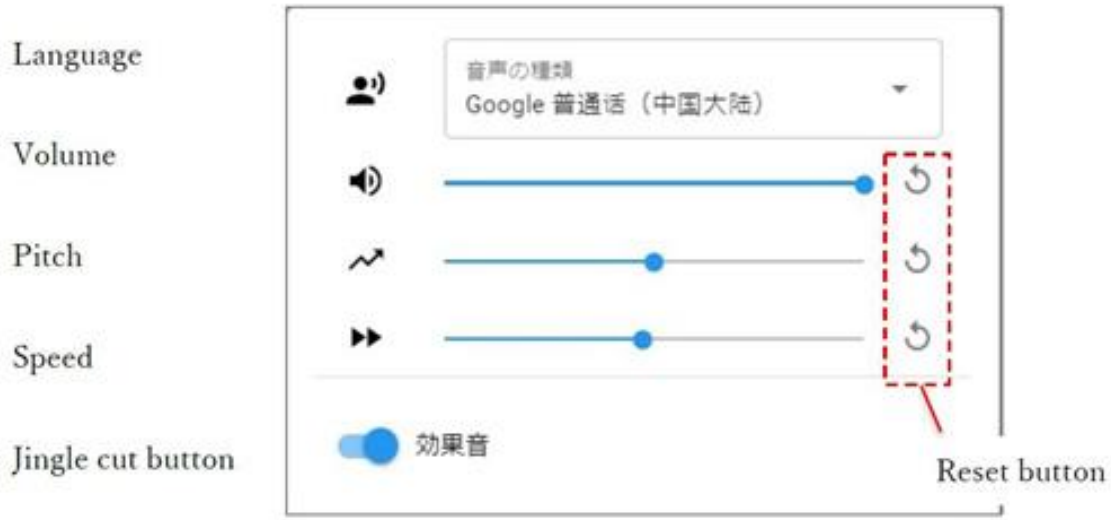

Figure 2 Synthesized Voice Adjustment screen

The training menus used in the classroom are “Reading Aloud Practice” and “Simulation Interpretation Practice.” The questions are created by the teacher using the ST

Lab material creation function based on the textbook used for the class. The addition of a material creation function is unique to ST Lab and was created by the author as this function is not available in any other CAPT system. "Reading Aloud Practice" includes "applied practice," in which each lesson's text and the grammatical points of that lesson are learned using previously learned words. When using this mode, students first learn sentence patterns in a standard lecture format, then practice pronunciation by chorus reading, and finally use ST Lab to read aloud the lesson ("Reading Aloud Practice"). Students who have reached 100% in providing the correct answer can go on to applied practice and follow up with "Simulation Interpretation Practice" to measure their understanding. The practice items are prepared so that students can practice according to their progress. Additionally, to make it easier to overcome students' weaknesses through focusing practice on the pronunciations that are found challenging during the learning process, a "weakness to overcome exercise" option is also included in the "Pinyin Reading Aloud Practice."

All questions are given randomly, and one problem is a set of 6-8 items. It is designed so that a student can repeatedly attempt a wrongly-answered question over and over again in a consecutive interval of time. Also, as mentioned above there is no time limit, and even if the wrong answer is repeated many times as long as the correct answer is entered in the end the item will be considered as the "correct answer." This is a form of repeated practice until the learner can answer correctly without fear of mistakes.

The speech recognition result is displayed in the answer text box (see Figure 1, #4). If it matches the question sentence, the "correct answer" message appears along with a chime and moves to the next question. If the answer is incorrect, an "incorrect" message appears, and the recognition result will continue to be displayed. The learner can listen to the wrong answer using the speech synthesis function by pressing button #8 seen in Figure 1. This function makes it easier to quickly realize what is incorrect in their pronunciation by comparing the difference between the correct answer and the student's incorrect answer.

The role that teachers play in this pronunciation practice is also essential. For example, they could help a student who cannot hear the sounds from the headset properly or who has problems with answering correctly by using the patrol function of the CALL system. Teachers can check answers and give feedback in the case that it is incorrect. They can also make suggestions about pronunciation if a wrong answer is given. For example, if a learner has entered 徒弟 [túdì; apprenticeship] for a question that is pronounced 土地 [tǔdì; land], the teacher can point out that the tone of the first syllable is incorrect and give the correct answer. This way, there is continuous communication between the teacher and student, which motivates the student to set clear goals and encourages him or her to keep practicing until the input is correct, even after several failures. This way of interaction makes the process of learning a fun experience.

After completing a set of questions, students see their score (see Figure 3). All of these grades are recorded for each question, and students can quickly check past grade changes from the questions interface (see Figure 4). Also, the average time that was necessary to submit the correct answer is also displayed on this screen, and it is possible to check the progress of pronunciation learning that cannot be known only by the correct answer rate.

Figure 3 Accuracy Rate Display screen

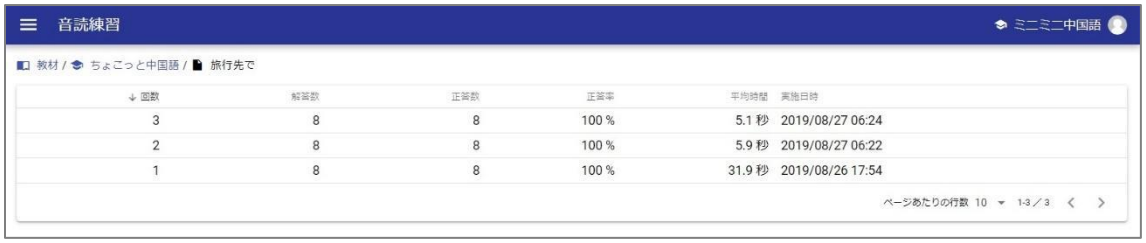

Figure 4 Learning History screen

3.2.2 Pinyin Reading Aloud Practice

"Pinyin Reading Aloud Practice" was created using the same template as "Reading Aloud Practice." The difference, however, is that pinyin is displayed in the text box that displays the Chinese sentence that forms the question in "Reading Aloud Practice." Other features, such as providing correct answers, reading incorrect answers, adjusting synthesized speech, skipping questions, etc. are the same as "Reading Aloud Practice."

Pinyin is not only a Chinese notation system.[8] It is also used for computer input. Therefore, it is important that Chinese learners master pinyin in the introductory stage. However, because Japanese learners can understand kanji, it is rather easy for them to understand the approximate meaning. So they frequently neglect practicing pronunciation. Therefore, "Reading Aloud Practice" includes exercises using simplified Chinese characters and "Pinyin Reading Aloud Practice" using pinyin, both of which are set as

[8] There are other Romanization systems for Chinese, such as Wade-Giles and Yale, but they are not currently used in Chinese language education in Japan. In Taiwan, Zhuyin phonetic characters {注音符號 zhùyīn fúhào] are used instead of Romanized letters to transcribe Chinese sounds. This system is not taught in Chinese language education in Japan either.

separate practice items.

3.2.3 Simulation Interpretation Practice

Even if a learner can reproduce a sound, it does not mean that the learner has mastered pronunciation unless one pronounces correctly and understands the meaning. For this reason, a mode of practice, "Simulation Interpretation Practice," is also included in ST Lab. It displays Japanese, asks the student translate the text into Chinese, and record it as speech.

"Simulation Interpretation Practice" uses the same template as "Reading Aloud Practice." But Japanese text is displayed instead of simplified characters in the text box where the question is posted. There are several ways of interpreting. However, since only one correct answer can be set in ST Lab, the exact answer provided to the learner is also a hint for learners to answer correctly. Other functions are the same as in "Reading Aloud Practice."

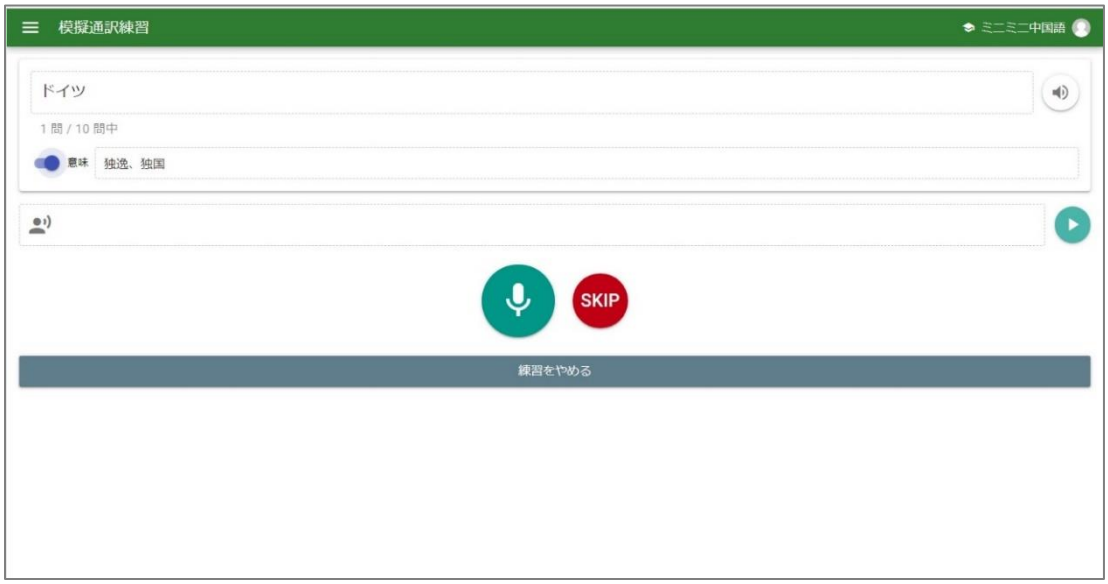

Figure 5 Simulation Interpretation Practice screen

3.2.4 Four Tones Listening Practice

The four Chinese tones are fundamental to Chinese pronunciation and are the first and most significant difficulty that learners encounter when learning Chinese sounds. Also, many students cannot speak Chinese well because the tones are challenging to master. Even if they have mastered grammar items to some extent they cannot complete their tone learning. The authors believe that tone learning practice is imperative for learning adequately. Hence, a "Four Tones Listening Practice" mode is included in ST Lab.

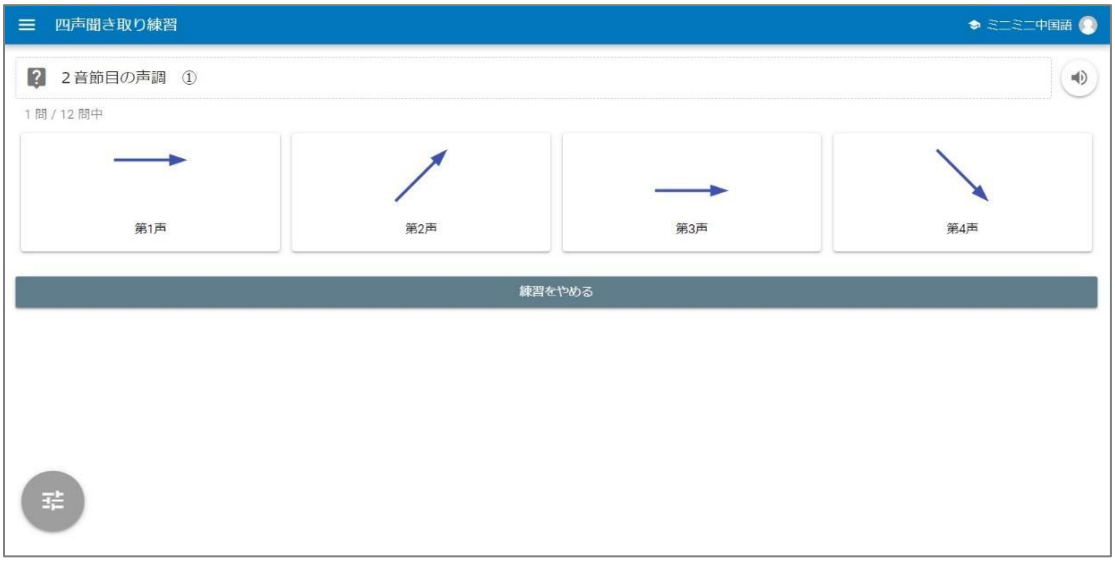

Figure 6 Four tones listening practice

In this mode, no letters are given, and the student learns to distinguish between the four tones, relying solely on the synthesized speech. In general, vowels and "ma" sounds are used as teaching materials to distinguish the four tones. In addition, ST Lab has prepared exercises using another voice to identify four different tones. Having more types of exercises available makes it easier for learners to discern the four tones of more types of sounds.

Learners listen to synthesized speech and answer a four-choice question. The synthesized speech can be heard as many times as necessary until it is answered. Once an answer is selected, a "correct answer" or "incorrect answer" message will appear along with the chime, and the next question will proceed regardless of the answer.

Each problem is 12 questions per set. After completing one set, the correct answer rate is shown as in the other exercises, and the learner can check what tones were missed to know where their own deficiencies in listening to the four tones are. It is also possible to check past learning history, the same as in other exercises.

The four tones form the basis of Chinese pronunciation and should be practiced over and over in the learning process. However, Japanese students often stop exercising after they mastered the differences between the four tones of a single vowel or one syllable. Such insufficient pronunciation practice is also a factor that strengthens the learner's notion that "Chinese pronunciation is too difficult to master." Thus, at Okinawa University, practice of the four tones is done occasionally and repeatedly throughout the whole year.

3.3 Interface for Management of Course and Materials by the Teacher

3.3.1 Organization, Subject, and Course Management Interface

The teacher's screen has two interfaces: subject and course management and creation of teaching materials. In either case, anyone who has administrator privileges can access them. At present, students are not allowed to make their own practice questions.

"Organization," "Subject," and "Course" have a hierarchical structure. Multiple "Subjects" can be created under one "Organization," and numerous "Courses" can be created in one "Subject." There are no restrictions on the number of sections. Only administrators can add and manage "Organizations."

Only the administrator can manage the user list of the entire system, and users with teacher status can browse the student list of the course they are in charge of. Teachers can also delete or add students if necessary. However, students who can be added are limited to those who belong to the same organization and have already registered. The student list is automatically created by adding names when a student registers. If the teacher has privileges, a student can be deleted from or added to the course attendee list.

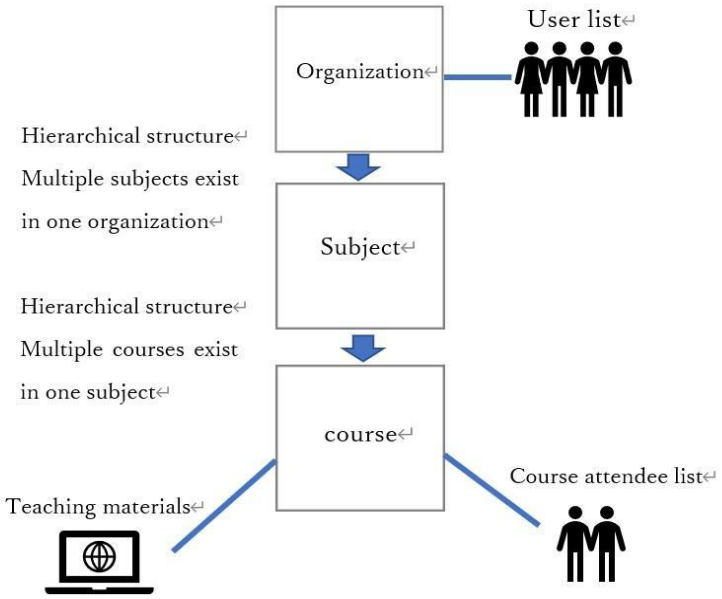

Figure 7 ST Lab object conceptual diagram

Teaching materials are linked to the course (see Figure 7). Instructors with teacher privileges can select teaching materials from a drop-down menu. These materials can be set to "Open to all" or made available only in their own course.

3.3.2 The Teaching Materials Creation Interface

The ability to create teaching materials is a unique feature not found in other pronunciation training software. With this feature, ST Lab allows any teacher to develop exercises based on any textbook or material. Only teachers and administrators have the authority to create teaching materials, and only the creator has the power to edit generated content.

To create teaching material, users first select a language to use for the speech recognition and speech synthesis from the drop-down menu. They then choose the scope of the teaching material to be made available from one of the following: "All courses," "Only the courses I am responsible for," or "Only myself."

Although it is possible to create hierarchical teaching materials (there is no limit to the number of levels either), it is still recommended that teachers develop only a few levels. This will make it easier to share materials with other teachers.

The teaching materials creation interface is composed of "Question," "Correct Answer," "Spoken String," and "Meaning" (see Figure 8). Among them, "Question" and "Correct Answer" are indispensable items for "Reading Aloud Practice." In "Pinyin Reading Aloud Practice" and "Simulation Interpretation Practice," "Question" and "Correct Answer" are different, so three items up to "Spoken String" are required. Because of this, the priority of speech synthesis in this system is set as "Question" < "Spoken string."

"Meaning" is not an essential item, but learners should understand meaning while mastering pronunciation. Therefore, it is recommended that teachers include "Meaning" in "Reading Aloud Practice" and "Pinyin Reading Aloud Practice." Also, note that to ensure that ST Lab can be operated on any OS, punctuation is removed from the "Correct Answer" string and the string captured by speech recognition before the two are compared.

When the speaker button is pressed in the question creation window, the synthesized voice can be heard. Voice recognition can be run by pressing the microphone button below it. This is a function to check whether synthesized speech and speech recognition are operating correctly. This feature was added because the need for it was realized through actual practice. For example, "1:45" can be written as "一点三刻" in Chinese, but in real speech recognition it will be displayed as "1 点三刻." "一点三刻" is correct in Chinese, but the system determines that the answer is incorrect, so the correct answer must be reset to "1 点三刻." This feature was added to allow a check in advance to avoid problems with speech recognition and speech synthesis that may occur when creating materials.

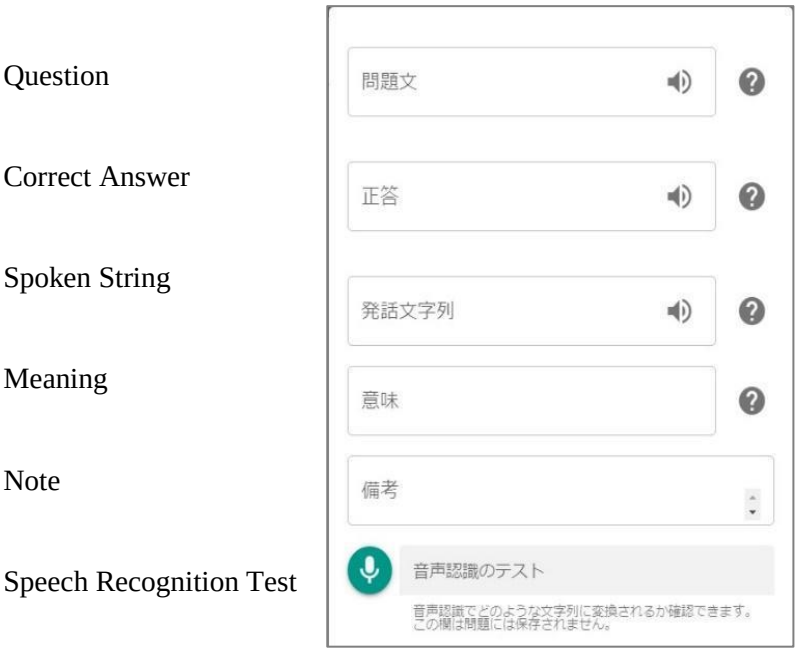

Figure 8 Question creation interface

Since "Four Tones Listening Practice" does not display "Question," the required items are "Correct Answer" and "Question" or "Spoken String," and "Correct Answer" is a half-width number. Each problem has 12 questions so that learners can listen to each tone three times in a four-choice listening problem. If four questions that differ only in tone are repeated, just set a group of queries made of four different tones and automatically replicate the issue three times at random. All items could also be arranged in different speech sounds.

4. Initial Outcomes of ST Lab on Learning Pronunciation

Since April 2018, ST Lab has been used for a year and a half in "Oral Chinese I" (first semester) and "Oral Chinese II" (second semester), which are common subjects for first-year students at Okinawa University. During the first semester of 2018 and the first semester of 2019, there were two class sessions a week with 25 students. None of the students had any previous Chinese learning experience. In the first semester of 2018, the first six weeks were used to learn pronunciation starting with "four tones" followed by practice of conversational sentences.

To make the practice of meaningless syllable pronunciation as short as possible, the speech-only lesson ended in half a month, a month earlier than usual. After that students started using "Reading Aloud Practice." The set of questions practiced was 16 combinations of 4 tones, excluding the neutral tone [轻声 qīngshēng], each with two words, totaling 32 words. Including explanations of pronunciation and meaning as well as demonstrations, this took two class periods (3 hours). In these three hours, 25 students

practiced 32 words 11,198 times (an average of 448 times per person), and this demonstrates that ST Lab promotes autonomous learning.

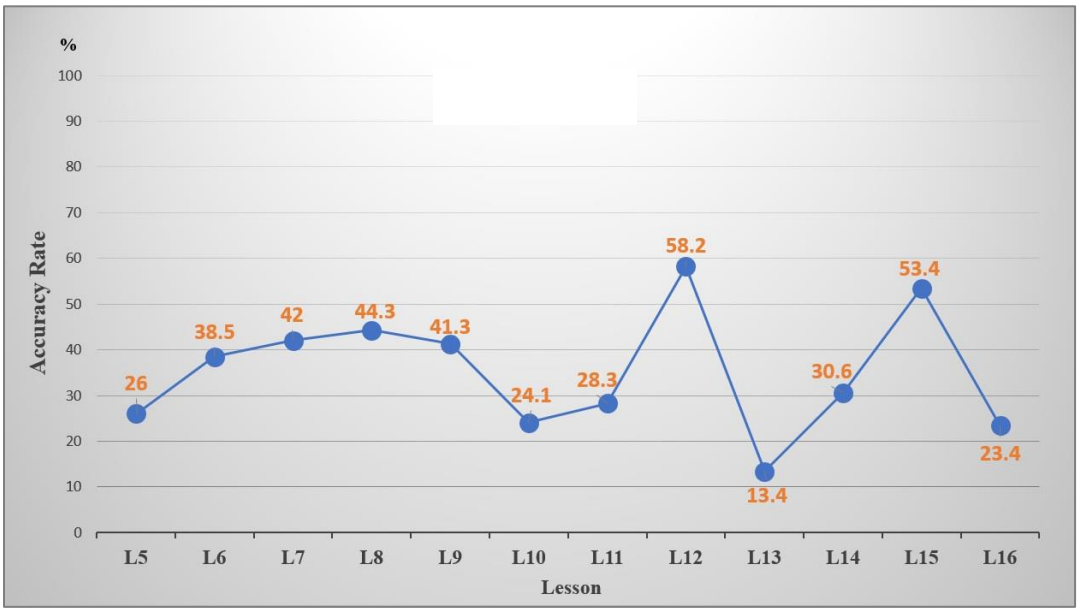

Figure 9 Accuracy rate for "Reading Aloud Practice" for each lesson in the first semester of 2018

Also, in the first semester of 2019, the correct answer rate did not increase as quickly as in the graph (see Figure 9). Although the correct answer rate is low in the practice of reading aloud in "Oral Chinese I," it can still be seen that learners continue to maintain high motivation to succeed in the following practice sessions despite drops in correct answer rates during some exercises (see Figure 9).

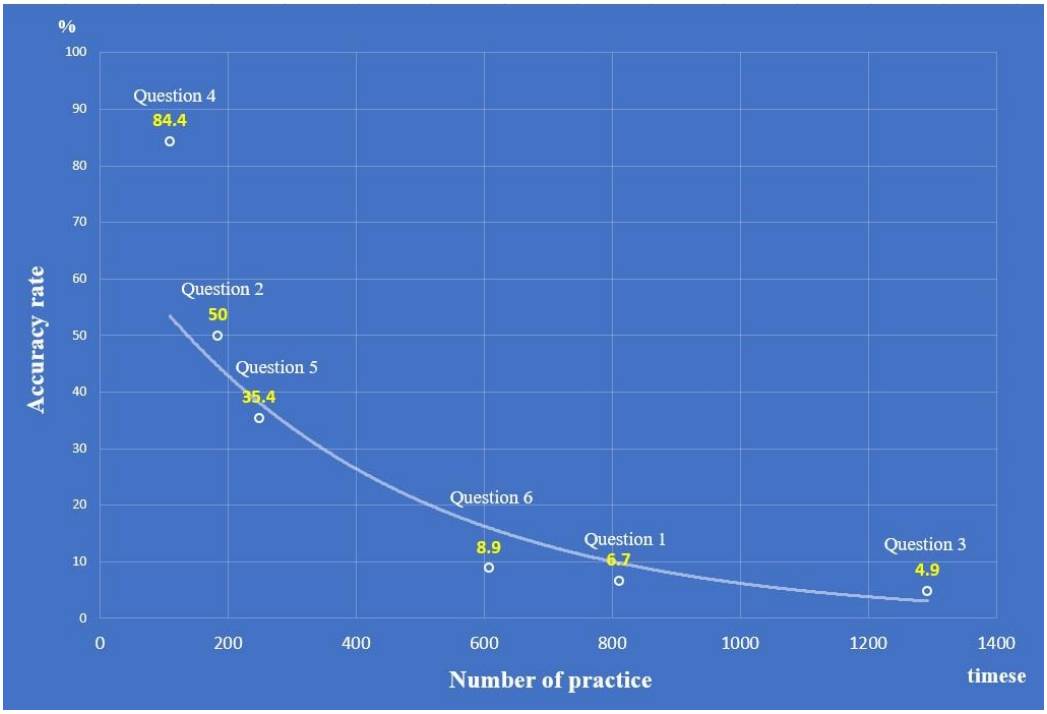

Figure 10 Correlation between the accuracy rate and the number of practice sessions of the 6 questions of Lesson 13 in the first semester of 2019

Figure 10 shows the correlation between the average accuracy rate of the six exercises in Lesson 13 and the total number of practice attempts performed by 25 students in the first semester of 2019. These correlation coefficients correlated strongly with r = -5.6. This means that the lower the correct answer rate, the more learners increased the number of times they practiced. If the learner did not get the right answer, the learner did more practice voluntarily. It is an ideal form of autonomous learning.

Also, in the last class of "Oral Chinese I" in the first half of the 2019 semester, a class evaluation questionnaire was conducted for all 25 students using Google Forms. In response to the question "do you think that pronunciation practice using the voice recognition function is effective?" nineteen students answered, "I strongly agree," and two students answered, "I think so." In total, 96% of students in the class thought that "practice using the speech recognition function is useful for learning pronunciation" (see Figure 11).

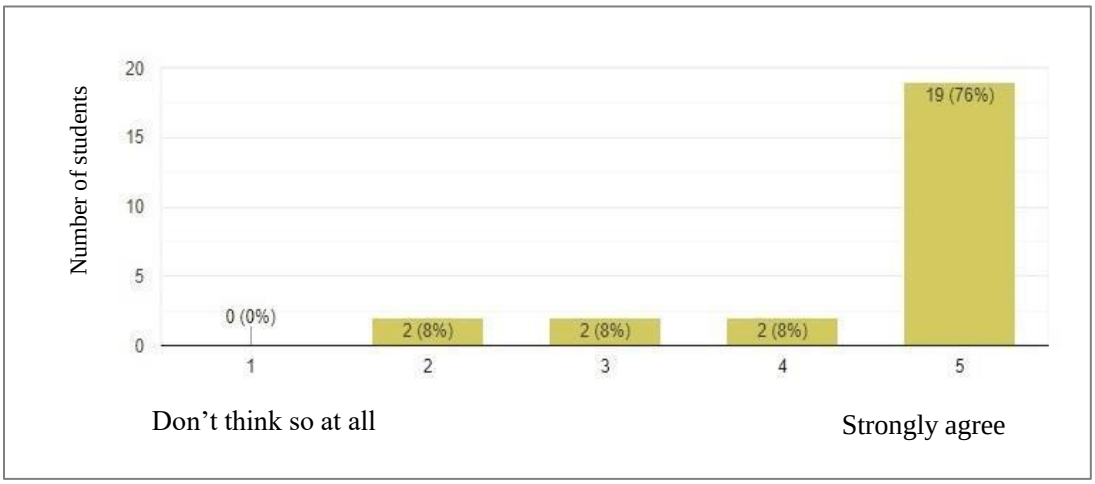

Figure 11 Questionnaire results on the effectiveness of speech recognition for learning pronunciation

The following are the results of asking "why it was useful" for students who replied that ST Lab speech recognition is useful for learning pronunciation (multiple answers allowed).

- Because users can know if their pronunciation is correct or not right away (21 people; 87.5%)
- Because users can see where the problem is in their pronunciation (17 people; 70.8%)
- Because the results are immediately known, so practice can proceed effectively (12 people; 50%)
- Because users can hear the sound of the correct answer repeatedly (19 people; 79.2%)
- Because users can concentrate without worrying about other people seeing them (4 people; 16.7%)
- Because users do not feel it is hard to repeatedly practice (7 people; 16.7%)
- Because users can feel that their pronunciation is improving (13 people; 54.2%)

ST Lab has been used in the class for only one and a half years, and the number of samples is not large enough. Nevertheless, pronunciation learning using a system (such as ST Lab) that provides immediate feedback on pronunciation shows in these preliminary results that it keeps the learner motivated to practice pronunciation and makes it easier to achieve a sense of accomplishment with the practice results. The above data and questionnaire results are considered to provide initial evidence to demonstrate these connections.

There were no students who complained about synthesized speech. To the question, "do you think that the speech synthesis function was useful for pronunciation practice?" twenty students (80%) replied, "I strongly agree," and four students (16%) answered, "I think so." This shows that the learners feel not only comfortable but also see synthesized speech actively and positively (see Figure 12).

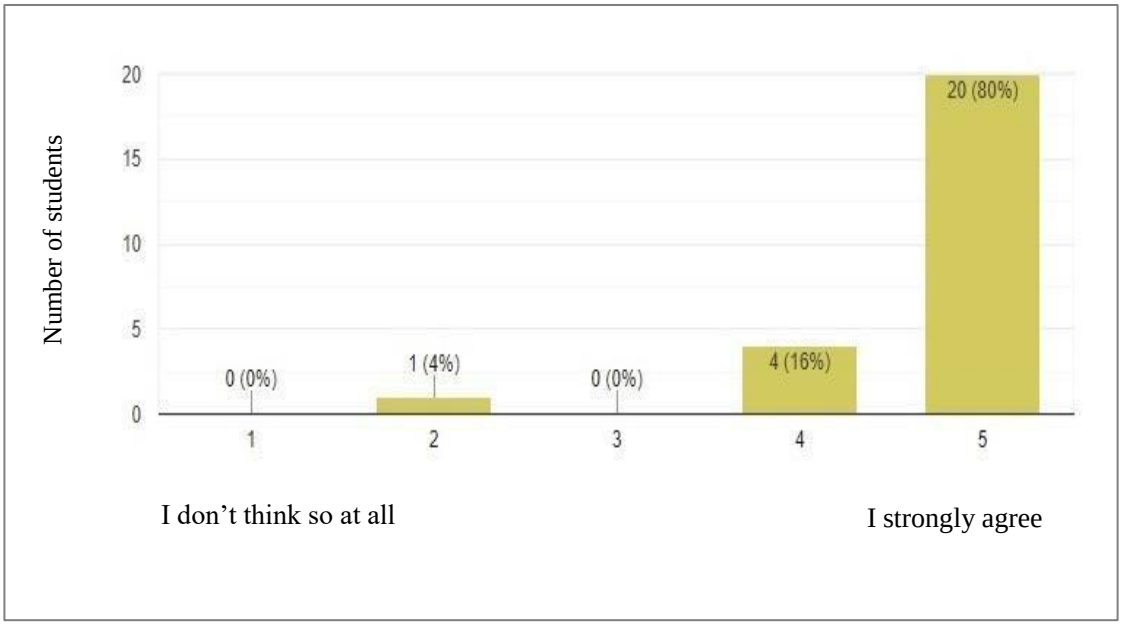

Figure 12 Questionnaire results on effectiveness of synthetic speech for pronunciation learning

In class, students were asked to practice listening using a different eLearning system as an extracurricular activity, and pronunciation practice was not required as an extracurricular activity. Despite this, two students (8%) voluntarily "practiced frequently outside school," and 17 students (68%) answered, "sometimes practiced." In total, nearly 80% of students practiced pronunciation independently.

Furthermore, when the students who practiced pronunciation outside school were asked, "did you use ST Lab during extracurricular practice?" it was found that students were also practicing pronunciation using the ST Lab outside school. This data also provides preliminary evidence that pronunciation learning using ST Lab can help students undertake "autonomous learning."

5. Conclusion

In this paper, we examined whether teaching Chinese pronunciation using speech recognition software is useful for learning pronunciation.

In order to answer this question, a new CAPT platform has been created, ST Lab, which provides new features not found previously in other platforms. A new feature that allows teachers to create and edit teaching material enables the class to work from any textbook and from any other language because the teacher can create exercises in ST Lab. Another addition is the inclusion of the "Simulated Interpretation Practice" feature, which allows ST Lab to help students practice the meaning of Chinese words and phrases where other platforms cannot. Even if students do not understand the meaning of a Chinese character, they can still learn the character through pinyin and listening to speech synthesis.

ST Lab can truly help students of different language backgrounds to learn Chinese because menus, prompts, and "Simulated Interpretation Practice" questions can be configured in any language to display text and synthesize speech while the speech recognition remains only in Chinese. Last, ST Lab is designed to work with speech recognition on any OS because it strips punctuation from both the teachers' "correct answer" and the result of speech recognition before the two are compared.

Utilizing ST Lab in the classroom, data was collected so as to ascertain the effectiveness of speech recognition and ST Lab's features to help Chinese-language learners. In the combination practice of two-syllable words in May 2018, 25 students practiced 11,198 times over 38 questions in less than 3 hours of class time. In the lessons from the first semester of 2019, it was found that the number of repeat attempts for exercises did not decrease, even for problems with a low average correct answer rate in the class. The students voluntarily repeated the exercise until the correct answer was given. Furthermore, there was a correlation between practice time becoming longer as speech input requested from students was becoming more difficult. Pronunciation practice is similar to sports, and it is traditionally believed that many repetitions of listening and speaking exercises will lead to progress.

Based on the questionnaire results, students believe that it is useful and practical to practice using a speech recognition function that can instantly determine whether the answer is correct or not. Additionally, the result of the survey demonstrates more than half of the students felt the system was useful and they used the system voluntarily during extracurricular hours. Both of these responses from students are desirable because a belief in the effectiveness of practice, together with a willingness to practice during free time, indicates that students will continue pronunciation practice independently.

From the above information, the authors found that teaching Chinese pronunciation using speech recognition is useful; it improves the learners' motivation and helps them to undertake "autonomous learning."

6. Future work

The first tasks are to increase the number of teachers using the system, to continue teaching with the system, to collect more data, and to prove the learning effectiveness of the system more scientifically. As mentioned earlier, this system has been available to the public since August 2019 and already has more than 300 users. In the future, the accumulation of data is very likely to provide more empirical evidence.

Still, there is room for further improvement. First, to make the teachers' responses more active, the cause of the incorrect answer derived from the wrong answer needs to be more scientifically analyzed. There is also a need to develop a system manual. For example, the learner's incorrect answer is not just a mistake of misunderstanding "徒弟" (apprenticeship) as "土地" (land). Because it occurs in multiple syllable tones, initials, and finals, the "incorrect answer" shows much different information. One author has used it for

over a year and a half, so it is known from experience what advice to use based on the content of the "incorrect answer" and what priority to use. However, it is difficult to share experiences because it is not organized intuitively. More effective feedback requires theoretical and systematic error analysis.

Currently, only students have access to their learning history. Teachers cannot access it, which creates a decrease in teacher-student interactions and understanding of student's progress. Teachers need to keep track of each student's learning progress to give the right guidance to every student and to get a better idea of their learning abilities. By using data from a server, what difficulties every student encounters while learning would be revealed, as well as how frequently they practice. It will be helpful in the future to have this data displayed graphically. That way, teachers will be able to follow the students' progress and the correct answer rate. It will also contribute to a more accurate understanding of learning progress. This feature is planned to be available in the next phase.

Future work also includes the implementation of a materials sharing function. As mentioned above, ST Lab can make the teaching materials settings "open to the public" and share them with other teachers. It is relatively easy to create teaching materials using the ST Lab's teaching material creation function. Still, it is unproductive for many teachers to develop similar materials from scratch. It is particularly easy to share such materials as "Four Tones Listening Practice." It is aimed to implement a material sharing community that will allow every teacher to add documents to existing ones.

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Reference

Furui, S. (2000). Perspectives on speech recognition technology. *Journal of the Phonetic Society of Japan*, *4*(3*)*, 60-63. [古井貞熙. (2000), 音声認識技術の現状と課題. *音声研究*, *4*(3), 60-63.]

Hayashi, T., Mizuochi, Y., Kiryu, T., & Kanzaki, H. (2012). A case study on translation activities by the speech recognition function of a tablet type terminal in elementary schools foreign language activities. *Japan Journal of Educational Technology,* 36 (Suppl.), 45-48. [林俊行, 水落芳明, 桐生徹, 神崎弘範. (2012). 小学校外国語活動におけるタブレット型端末の音声認識機能による翻訳活動に関する事例的研究. *日本教育工学会論文誌,* 36(Suppl.), 45-48.]

Iwai, H. (2013). Practice and research on German voice training with a speech recognition application. *Journal of Osaka University Graduate School of Human Science*, 2, 11-18. [岩居弘樹. (2013). 音声認識アプリを用いたドイツ語発音学習の実践と検証. *大阪大学高等教育研究,* 2, 11-18.]

Iwai, H. (2015). German voice training with a speech recognition application.

Osaka University Higher Education Studies, 3, 1-15. [岩居弘樹. (2015). 音声認識アプリを活用したドイツ語発音トレーニング. *大阪大学高等教育研究, 3,* 1-15.]

Li, Z. (2016). Trend of ICT utilization in foreign language education in Japan. *Journal of Osaka University Graduate School of Human Science, 42,* 329-341. [李哲. (2016). 日本の外国語教育における ICT 活用の研究動向. *大阪大学大学院人間科学研究科紀要, 42,* 329-341.]

Schwartz, A., Huang, C., Tao, J., Van T., Wolf, P., & Harada, Y. (2009). Evaluation the use of speech recognition in CALL systems. *The Technical Report of The Proceeding of the Institute of Electronics, 109*(297), 29-34. [Schwartz, Alan, Huang, Caroline, Tao, Jidong, Van Thong, J.M., & Wolf, Peter, 原田康也. (2009). ビデオ配信と音声認識を活用した英語学習システム：ＣＡＬＬシステムにおける音声認識利用の評価. *電子情報通信学会技術研究報告. TL, 思考と言語, 109*(297), 29-34.]

Sunaoka, K., & Iwamida, H. (2009). Listening education and its effect using Chinese Text-to-speech ―Changing language learning tools and learner's acceptability―. *Computer & Education, 27,* 28-32. [砂岡和子, 岩見田均. (2009). 中国語合成音利用の聴取教育とその効果 ―変わる語学ツールと学習者の受容能力―. *コンピュータ＆エデュケーション, 27,* 28-32.]

Tanabe, T. (2004). A study on the design of computer teaching materials in Chinese language education: Development of tone and autonomous learning materials in the introduction period. *Doshisha Studies in Language and Culture, 7,* 49-64. [田邉鉄. (2004). 中国語教育におけるコンピュータ教材デザインに関する考察―導入期の声調自律学習教材の開発―. *言語文化, 7,* 49-64.]

Watanabe, Y., & Omae, T. (2018). Developing Multilingual Learning Materials to Encourage Speech – The Potential of Speech Recognition and Synthesis APIs in Foreign Language Education. *2018 PC conference,* 56-59. [渡邉ゆきこ, 大前智美 (2018). 発話を促す多言語教材の開発–外国語教育における音声認識・合成 API の可能性. *2018 PC Conference 論文集,* 56-59.]

Watanabe, Y., & Omae, T. (2019). Development of Chinese phoneme retrieval system and trial of efficient pronunciation learning using speech recognition function. *2019 PC Conference,* 35-38. [渡邉ゆきこ, 大前智美. (2019). 中国語音韻検索システムの開発と音声認識機能を使った効率的発音学習の試み. *2019 PC Conference 論文集,* 34-38.]

Wei, W., & Zhang, J. (2018). An intelligent Chinese pronunciation teaching App and the preliminary result of a teaching experiment. *Journal of Technology and Chinese Language Teaching, 9*(2), 83-97. [魏巍, 张劲松. (2018). 一款汉语智能语音教学 App 及教学实验初步结果. *Journal of Technology and Chinese Language Teaching, 9*(2), 83-97.]

Zhao, X., Zhang, L., Ueno, T., Konno, F., & Mitsuishi, T. (2018). The practice of blended learning for beginning learners of Chinese at Tohoku University: Evaluation of the development of the textbook "KOTOTOMO". *Bulletin of the Institute for Excellence in Higher Education, Tohoku University, 4,* 149-163. [趙

秀敏, 張立波, 上野稔弘, 今野文子, 三石大. (2018). 東北大学初修中国語におけるブレンディッドラーニングの実践: 開発した教科書『KOTOTOMO』の検証を中心として. *東北大学高度教養教育・学生支援機構紀要, 4*, 149-163.]

Zhao, X., Tomita, N., Konno, F., Ohkawa, Y., & Mitsuishi, T. (2019). Development and practice of review material KoToToMo for use on smartphones in blended learning by beginning learners of Chinese in university. *Transactions of Japanese Society for Information and Systems in Education, 36*(2), 131-142. [趙秀敏, 冨田昇, 今野文子, 大河雄一, 三石大. (2019). 大学初修中国語ブレンディッドラーニングのためのスマートフォン利用復習教材「KoToToMo」の開発と実践. *教育システム情報学会誌, 36*(2), 131-142.]

http://www.tclt.us/journal/2019v10n2/zhang.pdf pp. 125-149

Learning Chinese Culture through Multimedia Authentic Materials and Ethnographic Interview in a Blended Learning Environment: A New Approach
(多媒体与民族志访谈相结合的文化教学方法在混合式教学环境下的运用：中文为外语教学中文化教学初探)

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Abstract: This study tests the effectiveness of a multi-modal approach to integrating culture in a language course for beginning learners. The approach combines the use of multimedia materials with an ethnographic interview with native speakers and it takes advantage of: 1) a blended learning environment that saves face-to-face meeting time for language practice, 2) easily-accessible authentic, multimedia materials available on the Internet, and 3) the plethora of Chinese national students on campuses in the United States. Thirty-three second-semester Chinese learners participated in this study. Data include pre- and post-questionnaires and a reflection essay. Results show that this approach not only teaches students about Chinese culture and increases their interest in learning the language, but also helps them acquire a method of learning culture.

摘要：文化在语言教学中的重要性已被语言教学研究者与教师广为认可，研究者也提出了不同的文化教学模式。然而迄今为止，验证这些教学模式是否有效的实证性研究几乎没有。本研究旨在探讨混合式教学中运用一个将多媒体与民族志访谈相结合的多模态文化教学方法对初级中文学习者的影响。此文化教学方法的设计基于三点考虑：1) 文化教学可融入混合式教学，以节约面对面课堂教学时间，使课堂教学集中于目标语练习；2) 文化教学可以合理利用网络上大量的免费多媒体资源； 3) 大量中国留学生涌入美国大学校园为中文学习者提供了一个独特的微文化环境，文化教学可以利用这一微文化环境。三十三位初级中文学习者参与了此项研究。通过对于前测后测问卷以及反思文章的分析，作者认为，此文化教学方法增进了学习者的文化知识，增强了学习者对中文学习的兴趣，而且让他们学会了一个新的学习文化的方法。

Keywords: Culture learning, blended learning environment, ethnographic interview, Chinese (Mandarin), multimedia authentic materials

关键词: 文化学习、混合式教学、多模态文化教学、多媒体教学、民族志访谈

1. Introduction

In 1974, Ned Seelye commented in his influential book titled *Teaching Culture: Strategies for Foreign Language Educators,* that "Knowledge of linguistic structure alone does not carry with it any special insight into the political, social, religious, or economic system" (Seelye, 1993, p.5). He underscored that "Learning a language in isolation of its cultural roots prevents one from becoming socialized into its contextual use" (Seeley, 1993, p.10). Over the past decades, the understanding of foreign language education professionals has shifted, with the goal of increasing learners' intercultural communication competence becoming more important (Kern, 2000; Paesani, Allen, & Dupuy, 2016; Rodriques, 2000; Ryshina-Pankova, 2015; 2018; Sawffar & Arens, 2005; Thorne, 2010).

Meanwhile, technology has enabled teachers to accomplish many things that they could have only imagined in the past, including using blended and online learning environments to enhance culture learning. Teachers also have had the access to free authentic multimedia materials on the Internet (Kern, 2015), of which many can be used to teach culture. In recent years, many Chinese featured videos, aka micro-movies (individually-produced short movies) have become available online. These movies are excellent resources for learning about Chinese culture. Using multimedia for teaching languages (Chapelle, 1998; Grgurović & Hegelheimer, 2007; Yanguas, 2009) and culture (Brown, 2010; Desai, Jabeen, Abdul, & Rao, 2018; Sun, 2013; Kim & Weber-Fève, 2015) is not a new idea, but now teachers can take advantage of the widely available resources in their teaching at a low cost (Zhang, 2015; Zhang, 2016a; Zhang, 2016b).

With the influx of international students from mainland China, CFL learners can experience Chinese culture on campus without the need to go to China. It would be a pity if we did not teach CFL learners to utilize this opportunity. Working together, the blended and online learning environment, the free authentic multimedia materials on the Internet, and the influx of Chinese students on American campuses, can make it convenient to strengthen culture learning.

The importance of cultural learning has been widely recognized, and numerous models of culture learning and approaches to teaching culture have been proposed. Based on many models, Byram (1997) introduced the Intercultural Communicative Competence (ICC) model, proposing that to achieve competence, learners should develop the five *savoirs* (savoir être, savoirs, savoir comprendre, savoir apprendre/faire, and savoir s'engager). Foreign language learners are intercultural speakers who are honing their abilities to learn and achieve a competence that extends beyond the classroom, allowing them to be independent throughout their lives. Kramsch (1993) introduced the notion of "third culture/place." Viewing that "in most foreign language classrooms, interculturality is not being taught as systematic apprenticeship of difference nor is it generally integrated

into a multicultural view of education" (Kramsch, 1993, p. 235), the concept of third culture was created to "capture the experience of the boundary between NS and NNS" (Kramsch, 2009, p. 239). Meanwhile, Piątkowska (2015) distinguished three approaches of integrating culture into language learning: the knowledge-based approach, the contrastive approach and the intercultural communicative competence approach. Other approaches include using authentic materials, field trips, video showing etc.

However, there is a remarkable scarcity of empirical studies on culture teaching in the classroom (Byram, 2014; Boutin, 1993). There are studies using Computer-Mediated Communication (CMC) such as Pinterest to raise students' cultural awareness (Angelova & Zhao, 2014; Knouse & Abreu, 2016; Oakley, Pegrum, Xiong, Lim, & Yan, 2018; Schenker, 2013). To the best knowledge of the author, only one empirical study has been conducted. Robinson-Stuart and Nocon (1996) examined the effects of an ethnographic approach on Spanish learners' motivation. They found that the ethnography project brought positive perceptual, affective and cognitive changes to the students and that the students' attitude towards the study of Spanish had improved. However, Robinson-Stuart and Nocon's study focused on the intermediate level Spanish learners. No research has been done on introducing culture learning to beginning level Chinese language learners. An empirically-tested approach to teaching culture to language learners, especially beginners is urgently needed. This study is thus to test the effectiveness of a multi-modal approach that was designed for beginning level CFL learners to learn culture in a blended learning environment by utilizing multimedia materials and ethnographic interviews with native speakers (NS) of the target language (TL).

2. Theoretical Framework

Two theoretical assumptions undergird this study: First, learning takes place through interaction and communication with others (Vygotsky, 1962; 1971). According to Vygotsky, learners' development happens through participation in cultural, linguistic and social settings. Learning occurs within social contexts involving student-to-student and expert-to-student collaboration tasks built on each participant's "language, skills, and experience shaped by each individual's culture" (Vygotsky, 1971, p. 102). Learning is a process of transformation from an interpersonal process into an intrapersonal one, that is, a process of internalization as "the result of a long series of development events" with expert support (Vygotsky, 1971, p. 57).

Second, a blended learning environment could allow for an improved pedagogy, increased access and flexibility (Graham, 2006). Combining Face-to-Face (FTF) instruction and computer-mediated instruction, blended learning was conceptualized as "new culture of learning" (Thomas & Brown, 2011, p. 17), where engagement with learning happens in a distributed environment. Educators choose a blended learning environment for three primary reasons: 1. Improved pedagogy; 2. Increased access and flexibility; and 3. Increased cost effectiveness (Graham, Allen, & Ure, 2003; 2005). Blending can happen at multiple levels depending on the needs of instructors such as activity-level, course-level, program-level, and institution-level (Graham, 2006).

3. Research Questions

To improve students' cultural awareness and their attitude towards learning the TL, a culture learning approach was designed and implemented. To determine if the approach is effective the following research questions were identified:

1. Is the approach effective in improving students' a) cultural awareness; b) awareness of culture learning resources; c) attitude toward the community of people who speak that language; d) interest in learning the Chinese language?
2. Do students believe that they have "learned how to learn" about other cultures from this approach?
3. What are students' perceptions of this approach?

4. Methodology

This study adopted a mixed method research design to investigate the effectiveness of the approach and students' perceptions. A total of 33 second-semester CFL learners in two classes at a large, mid-western university in the United States participated in the study. Demographic statistics of the participating students are presented in Table 1.

Table 1 Demographic statistics of the participants

Variables	N (33)	%
Gender		
Male	21	64
Female	12	36
Native Language		
English	25	76
Malay	4	12
Hmong	1	3
Portuguese	1	3
Vietnamese	1	3
Spanish	1	3
Chinese as Their First Foreign Language		
Yes	18	55
No	15	45
Chinese Heritage Learner		

Yes	1	3
No	32	97

A majority of the participants (67%) started to learn Chinese out of personal interest, and 21% of them started to learn because they felt it was fun. Only a small number of participants started to learn because it was required or out of family pressure. (See Figure 1).

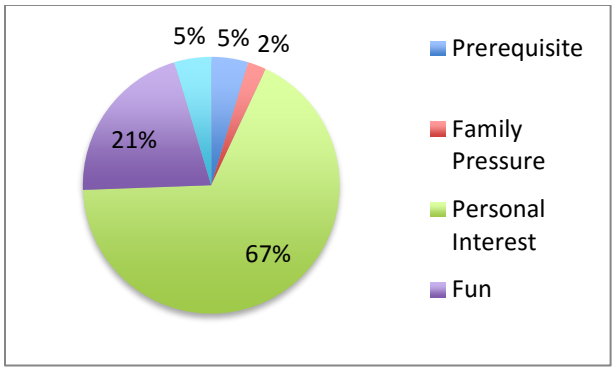

Figure 1 Why did you start to study Chinese?

Before and after the culture learning approach was implemented, participants filled out a questionnaire. This questionnaire was designed based on Gardner (1985) to assess the students' culture awareness, their interests in learning the Chinese language, and their awareness of resources in learning about Chinese culture. After the culture approach was implemented, the participants filled out a post-survey containing Likert scale items and open questions. This was to assess participants' self-perception of the approach and the effect of the approach had on their motivation and interest in learning the language and the culture, their attitude toward people in the target culture community, their culture learning method, and their views about the approach. In addition, participants were required to write a reflection paper at the end of the semester, which was also used as data.

The pre and post questionnaire data were analyzed using a one-tailed t-test. The Likert scale items in the post-questionnaire were analyzed using descriptive statistics. The answers to the open questions and the reflection papers were analyzed based on grounded theory using open-and-axial coding approach (Corbin & Strauss, 1990) to identify emerging thematic patterns. Key points were extracted from the reflection papers and the answers to the open questions in the survey are marked with a series of codes. The coded items were grouped into categories. The initial coding was revisited and re-evaluated and items were grouped into similar categories, from which patterns were identified.

5. The Culture Learning Approach

5.1 The Design Principles

The widely available multimedia materials on the Internet used in teaching should lead students to comprehend the way language interacts with the sign system of its culture, including not only linguistic and paralinguistic signs but also cultural artifacts such as traffic noise, folk music, pictures, landscapes (Kramsch, 1999; Kress & van Leuwwen, 1996). Considering these factors, this approach was designed based on four principles which correspond to the four considerations identified by Kramsch (1993).

First, help students establish a 'sphere of interculturality' by comparing their native culture and the target culture (also see Schulz, 2007). "Understanding a foreign culture requires putting that culture in relation with one's own […] thus, […] an intercultural approach to the teaching of culture is radically different from a transfer of information between cultures" (Kramsch, 1993, p. 205). Paige et al. (2003) suggested that one technique that could help students establish a sphere of interculturality is reflective observation. We should encourage and develop "an exploratory and reflective approach" to culture learning (Newton, et al., 2010, p. 63).

Second, help students learn culture through an interpersonal process. Meaning emerges through social interaction; therefore, when only fixed and normative phenomena of language use are taught, it does not help with learning. "[T]he teaching of a process that applies itself to understanding foreignness or 'otherness'" (Kramsch, 1993, p. 206) should be encouraged. To become effective culture learners, students should develop a variety of learning strategies ranging from reflective observation to active experimentation or experiential learning" (Kolb, 1984; Paige et al., 2003). Newton et al. (2010) also found that to learn culture, learners should be encouraged to engage in genuine social interaction.

Third, help students become aware of the multiple aspects of differences in culture. Sometimes it is easy to view culture as a national trait. However, "National traits are but one of the many aspects of a person's 'culture'" (Kramsch, 1993, p. 206). With the increase of multicultural identities, it is important to take into consideration the other sub-cultural factors such as age, gender, region, and ethnicity.

Fourth, identify effective ways that could help students learn culture, regardless of the discipline they originate. We need to cross disciplinary boundaries to find the most suitable method for integrating culture teaching in practice. One of the methods is the ethnographic approach drawn from anthropology.

Based on the aforementioned principles and in consideration of the availability of resources, this approach was designed with an integrated blended approach using authentic videos and ethnographic interviews. The purpose is to enhance students' understanding of the target culture, improve their attitudes and motivations for learning about the TL and culture, and provide them with a learning method to use in the future to become life-long culture learners.

5.2 The Phases of the Approach

The approach has three phases that take place mainly outside the classroom. The first phase focuses on learning from instructor-selected and instructor-edited authentic multimedia materials. The second phase focuses on learning from interactions with TL speakers, i.e., through ethnographic interviews. The third phase focuses on student reflections of their culture learning. The first two phases involve two different methods of learning culture, while the last phase complements the first two and allows the students to delve deeper into culture learning. See Figure 2 for the flow chart of the approach.

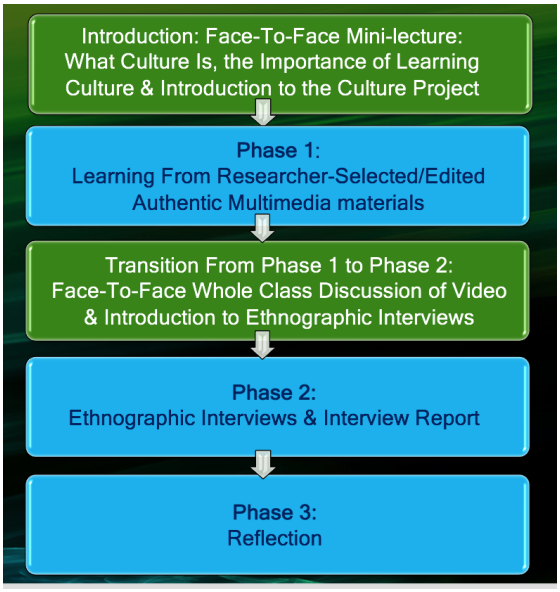

Figure 2 Flow chart of the approach

5.2.1 Phase 1: Learning from Authentic Multimedia Materials

Phase 1 is divided into three steps. Step 1: Watch the micro-movie or a film clip provided by the instructor (in English or in Chinese). Step 2: Answer a series of instructor-created questions about the movie/clip. Step 3: Participate in the online discussion about the movie/clip (in English). Each week, the students watched one movie/clip in the three steps, as shown in Figure 3.

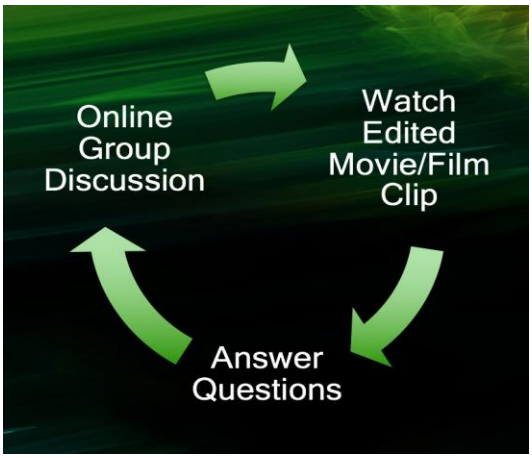

Figure 3 A cycle happened in Phase 1

Movie selection and editing. The criteria for selecting authentic multimedia materials include: current, accurate, and interesting sources that reflect the "little c" culture. The micro movies and the film clips were edited to make sure students use the English translation to understand particular scenes by providing additional information with respect to culture. Because existing English subtitles do not always accurately render subtle differences in the target culture, the editing provides a direct translation of the TL with brief explanation of the culture point to facilitate understanding.

For this phase, three movie/film clips were selected and edited that focused on different Chinese cultural topics, such as mother's love, respect for the dead, dining etiquette, giving gifts, and being a guest. These culture themes were chosen because they are important and universal but different in different cultures. One was a three-minute micro-movie titled *Mother* which addresses a mother's love for her child with a uniquely Chinese cultural perspective. In the movie, other special Chinese cultural aspects were also addressed, such as how unrelated people address each other, adults' interaction with children, and how people show respect to their deceased loved ones. The other two film clips came from Ang Lee's *Eat Drink Man Woman*. The first one was 33 seconds long and was about how a host and hostess treat their guests, how guests and the host/hostess interact, and gift giving etiquette. The other clip (1 minute and 7 seconds) provided a scene about dinning etiquette.

The primary purpose of the editing was to add an introduction to the movie/film clips and translate what the characters' dialogue meant directly with the intention of keeping the culture connotations. For example, in a scene in which an elderly woman, the protagonist in the movie, came across a young mother and her little girl, the woman commented on the little girl by saying "真乖" (zhēn guāi). The use of 乖 reflects the culture. While 真 means "really," 乖 means "behave so well by being respectful to others", which stressed that the relationship with other people is important in Chinese culture. 乖 is very commonly used to comment on younger children, illustrating how Chinese people expect children to behave. The official translation provided by the film was "What a lovely girl!" which puts emphasis on the girl herself and loses the cultural

connotations in the words. Editing by the instructor supplements the original translation (or omission) by adding notes "乖 guāi, is a word used for praising a child in China. It means "(you) behave so well by respecting others." See Figure 4.

Figure 4 A scene from the micro-movie, *Mother*, with notes added by instructor

Another example is from *Eat Drink Man Woman*. When the host serves dinner, he says "不成敬意不成敬意，随便用". The official dubbing translation was "It's a simple meal! Please help yourself," which somewhat obscured the cultural signification or references in the scene because "不成敬意" does not just mean "it is a simple meal." The more accurate translation is "it is too simple to show my respect." In all situations when this phrase is used, the action or the service the speaker performs is far above what is expected, but using this phrase indicates humility, and in this case, the humility, sincerity, and respect of the host toward his guests, despite the generous and hearty dinner he prepared for them. See Figure 5.

Figure 5 A scene from the film *Eat Drink Man Woman*, with notes and translation added by instructor

Design of the questions on the movie/film clips. The questions for the students were designed to raise students' awareness of special cultural points shown in the movie clips. In order to make sure that students understand the setting of the movie without confusing it as representing all of China, students were asked "Is this in rural China or urban China?" The way unrelated people (familiar or unfamiliar) address one another is a unique Chinese cultural point. In order to call students' attention to how acquaintances address each other, questions were asked such as, "How did the young mother address the elderly woman? Is she related to the elderly woman?" What people say when they depart is also a cultural point that students should notice, so questions were designed such as, "What did the young mother say when she was about to leave?" "What would people in your culture say when one needs to leave during a conversation?" Questions such as "What do you do and how do you react in this situation in your culture?" were designed in order to encourage students to reflect on their own culture and make comparisons between the two cultures (Fenner, 2000).

Online group discussion. The online group discussion asked students to make comparisons between their own culture and Chinese culture. In addition, the discussion provided an opportunity for students to deepen their understanding of the cultural aspects reflected in the movie/clips by interacting with each other. Five to six students with different cultural backgrounds, gender, and ages composed each group. The diversity in each group was meant to elicit different views about Chinese culture and expand the perspectives of the individual participants.

5.2.2 Phase 2: Ethnographic interviews

The second phase adopts the method of ethnographic interviews. The ethnographic interview is a well-established research method in anthropology in which immersive observation and directed one-on-one interviews are used for contextual inquiry to gather qualitative data (Damen, 1987; Spindler & Spindler, 1987). Research suggests that ethnography can be used in second language learners, but literature describing its use is scarce (Allen, 2000; Arries, 1994; Barro, Byram, Grimm, & Roberts, 1993; Hickey, 1980; Morain 1983). In this study, ethnographic interviews were used to complement the online learning from multimedia materials.

By the time they watched the video clips, answered questions, finished the online group discussion, and received answers to any pending questions (during the FTF discussion session), students had established some preliminary ideas about the differences between their own culture and Chinese culture. They may not have totally understood some dimensions of the assigned topics, and they may have wanted to explore Chinese culture further. At this point, the ethnographic interview activity was introduced to provide an opportunity for further discovery through interpersonal contacts with students from the target culture. Prior to the ethnographic interview activity, the instructor introduced the framework, requirements and procedures for the interview, and then demonstrated how to conduct an ethnographic interview. To complete the interview, students needed to decide on a topic, prepared questions, conducted the interview, and composed an interview report that described the process and their findings. A partial sample of a student's interview report is provided in Figure 6.

[redacted], May 23

Friends Far, Friends Near

Walking into my friend's room at the Hyland Apartment complex, I smelt a strange, yet comforting scent of cooking--like a late breakfast of vegetable dumplings--that hung in the air and occupied the whole room. Noticing how strangely designed the entrance door was, I realized that the kitchen was exposed (in a bar-like manner) to the main room, explaining why the smell was so strong. Even though the kitchen was a mess, it was pretty interesting in the fact that the dishes were the kind that are white with a lovely blue design around the edges. In addition, there were *chopsticks*. Continuing on into the front room, there were blankets draped over a rope, as if it was a wall of a fort (to which I found out later it was a friend of my friend's housemate needing a place to stay).

My friend offered me a seat which was placed next to the kitchen's bar, and immediately offered me dumplings. I reluctantly accepted (since I ate beforehand), and we began to chat. It has been a while since I saw my friend, [redacted]. Born and raised in Nanjing, China, [redacted] grew up with the English language taught in his school. I've (surprisingly) met him while I was on a trip in China at the Elephant's Trunk, Guilin, Guangxi, China--the funny thing is that we were both on vacation. It turned out that he was only a few months younger than me, and he was going to the same college! With him was his girlfriend and my fellow design classmate, Wanting Sun. She is a few months older than me, and she has learned English in her academic years. She is also from Shanghai, where [redacted] went to high school. What a small world.

Figure 6 A sample of the student interview report

5.2.3 Phase 3: Reflection

The third phase is reflection, a proven key in gaining developmental opportunities (Dewey, 1933; Hatcher & Bringle, 1997). "Reflective inquiry invites a consideration of how we know, how we learn and asks us to be attentive to our own awareness, to become conscious of ourselves as knowers" (Lyon, 2010, p. 26). This is also the fundamental process through which human beings gain knowledge from their experiences (Boud, Keogh, & Walker, 1985; Guthrie & Bertrand, 2012). As an important form of personal response to experiences, situations, events, or new information where thinking and learning take place, reflection has been proven to be a critical step in learning.

After the students finished the online discussion and the ethnographic interview, they wrote a reflection paper that included their feelings, thoughts, and experience conducting this culture project. Students were given instructions on how to write a reflection paper and what they were trying to accomplish. Figure 7 is a partial sample reflection written by one student.

[redacted], reflection, April 30

With the school year coming to an end, these two semesters of Chinese language classes have prepared me exceptionally well for my future endeavors as an ESL teacher, as well as a traveler, and ultimately, as a global citizen. In just two semesters, I find myself confident enough with my language abilities to converse with other (patient) people, whereas when I began learning [redacted], it took me about four years until I was proficient enough to communicate with conviction. Although learning the language has been an outstanding experience for me, the culture project helped me to realize that there is much more to learning a language than vocabulary and grammar. Culture is reflected in every language of the world. The two go hand-in-hand, and after completing the culture project, it's clear to me why language education is not complete without at least a crash-course in culture. In this particular course, I'm thankful to have had the opportunity to receive the best authentic resources and guidance to learn about Chinese culture.

I've learned many new things about Chinese culture, but the most fascinating for me are the things that show up in everyday speech. For example, '你吃了吗?' this greeting infuses food culture of China in with language! It outlines the importance of food in the culture, and how it's involved in relationships between friends. In our own culture, however, a simple 'hello,' will do for strangers and friends alike. Additionally, the kinship terms used to address close friends are very different from our own culture. As demonstrated in the videos we watched, kinship terms such as 'grandma,' 'grandpa,' and 'auntie' are used to address close family friends, as well as blood relatives. This indicates a stronger set of relationships than most Americans have, since it seems that we have more distance between those of us who are not exclusively related. It was great to see multiple examples of these linguistic phrases, too. That way, we are able to compare and contrast the phrases with one another, seeing when, where, and with whom it's appropriate to use them.

Figure 7 A partial sample of student reflection

Time Distribution. The three phases of this culture learning approach requires students to spend most of their time learning culture outside of the FTF class time. However, there are two class sessions during which such learning happens in the classroom. The first occurred at the beginning of the culture project when the instructor gave a short (about 20 minutes) FTF mini-lecture in English about what culture is and why it is important to learn culture while learning a foreign language. This mini-lecture included the differences between the "big C" culture and the "little c" culture. The instructor used what it meant to be polite in China as an example in explaining the "little c" culture, such as how to greet different people with such different registers as seniority, gender, relationship and age, what to say upon receiving praise, and how to start a conversation with different people.

The second FTF activity took place after Phase 1was finished. This activity brought the whole class together to discuss the movies/film clips. The instructor also answered questions from students. During this meeting (about 30 minutes), Phase 2 was introduced; students learned what an ethnographic interview is, and they viewed sample ethnographic interviews. See Figure 8, in which the size of the circles indicates the appropriate time they spent on each activity.

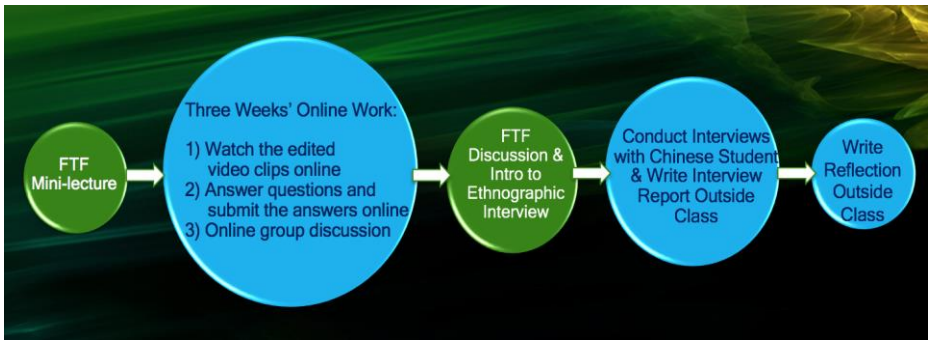

Figure 8 Approximate amount of time distribution (FTF Versus Online) of the process

6. Findings

The results show that using the culture learning approach combining multimedia authentic materials and ethnographic interviews in a blended environment improved learners' cultural awareness and their interests in learning the Chinese language. The students' attitudes towards the community of people who speak Chinese also changed. The pre and post questionnaires only show that the participants became more aware of culture learning resources but did not show that they have learned a method of learning culture. However, the reflection papers reported that they have learned new *ways* of learning culture. In addition, they reported that they have not only learned about culture, but also learned how to interact with people from a different cultural background.

6.1 Pre- and Post-Questionnaire

The results of the one tailed t-test showed that the students' interest in learning the Chinese language was significantly improved after the implementation of the culture learning approach, showing statistically significant improvement at the 0.05 level (See Table 2). As noted above, 67% of students responded that they were enrolled in the Chinese course because of their personal interest in learning the language. These results indicate that despite the fact that the students were interested in learning Chinese before using this approach, they became even more interested in Chinese learning after using this approach.

The one tailed t-test shows that there was no significant change in students' perception regarding their knowledge about methods of learning culture. However, results show that the students became more aware of the resources for culture learning, such as micro-movies on the Internet, NS on campus, and Quora.com after implementing the learning approach. The improvement in their score for awareness of culture learning resources is statistically significant at the .025 level (See Table 2).

Table 2 Changes in participants' interest in learning the Chinese language, awareness of resources for learning about Chinese culture, and knowledge of culture learning methods

	Interest in learning Chinese language	Awareness of resources	Knowledge about Culture Learning Method
M pre-questionnaire	27.10	3.81	3.85
M Post-questionnaire	28.82	4.45	4.67
P (one-tailed t-test)	0.036	0.012	4.22

6.2 Post-survey Likert scale items

The post survey data show that the participants' attitudes towards the people in the target culture community has changed positively. After the culture project, they reported that they had more respect for and understanding of people from China or Taiwan. See Figure 9.

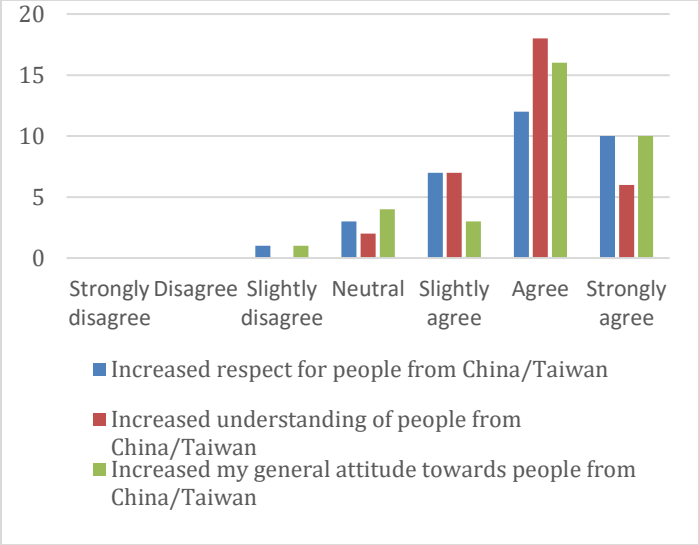

Figure 9 Participants' self-perception of their positive change

In the survey, participants reported that after the culture project they had become more interested in learning the Chinese language. This finding confirmed the findings in the pre and post questionnaire data (See Figure 10). Participants also reported that they had learned about Chinese culture, improved their understanding of their own culture, and increased their understanding of the differences between the two cultures (See Figure 11).

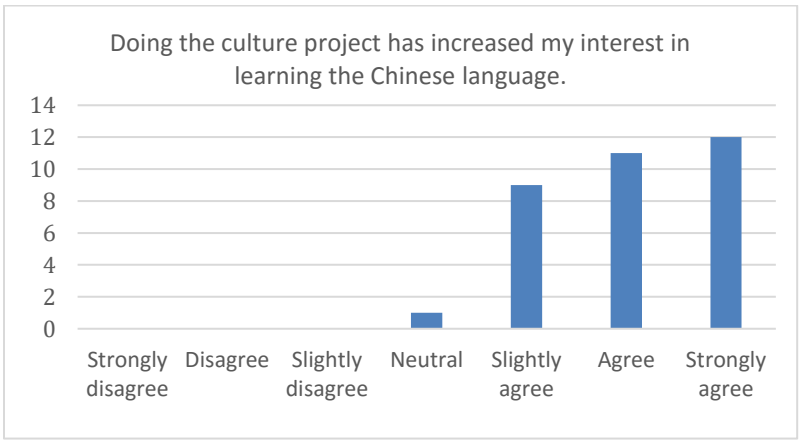

Figure 10 Participant's self-perceived change in interest in learning the Chinese language

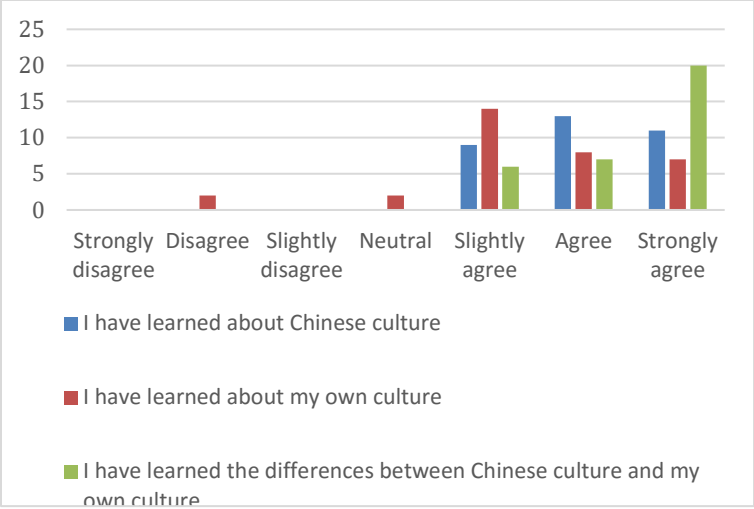

Figure 11 Student self-perceived change in culture awareness and the culture differences

In addition, participants reported that they had learned how to interact with people from China or Taiwan and how to learn about culture. See Figure 12.

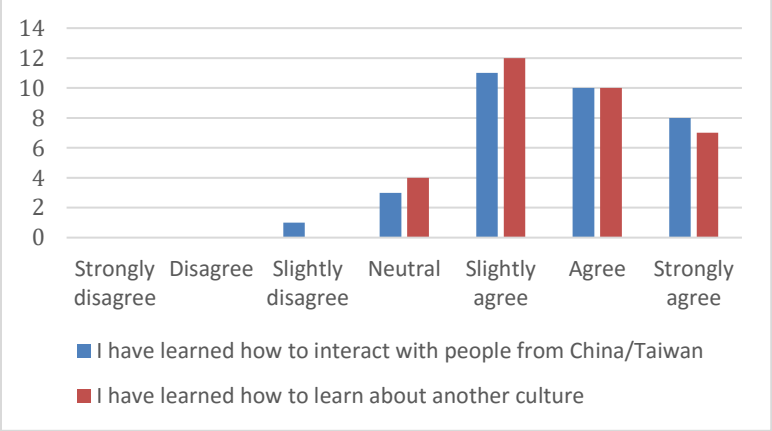

Figure 12 Participants' perceptions of changes in their culture learning method

When results of the survey question on the culture learning method are compared to results of the pre and post questionnaire items addressing the same construct, there is a discrepancy. Most participants agreed that they learned how to learn about another culture. However, there was no significant improvement in the learning *method* between the results of the pre and post questionnaires, which could be a result of the item's wording. The pre and post questionnaire item addressing this construct was "I know how to learn culture." The students might have thought that they knew how to learn about culture before doing the culture project. Different people have different understandings of what culture is. For most people, culture takes the form of "big C" culture. After they completed the culture project, participants' perception that they knew how to learn about another culture had not changed, even if the methods for doing so may have changed. One of the themes in participants' reflection papers also proved this point, as illustrated in the following section.

The analysis of the responses to the open-ended question in the post-survey shows that all participants enjoyed completing the culture project. Responses also showed that the approach had a positive impact on their culture learning and that the implementation of the approach had changed the students' attitude towards community of people who speak Chinese. This culture learning approach provided students with an opportunity, in a student's words, "to learn information about the real world from a classroom atmosphere."

Some of the reasons participants gave for enjoying the project included: learning a lot about Chinese culture rather than just learning the language, "taking a break from language skills," having a fun way to learn culture, being "not super hard", and "not too time consuming," and being spread over a several weeks. The project also encouraged them to "seek out sources otherwise might not have." Overall, students liked "the opportunity to learn how to learn about other culture" and said, "it was short but useful to learn more about the culture."

6.3 A Spectrum of Learning Outcomes: From Culture Itself to Methods of Learning about Culture

*First, the participants learned the importance of culture learning and different aspects of Chinese culture***.** The quantitative data show that the culture project significantly improved students' cultural awareness. The participants not only realized the importance of learning culture (as one student put it, "I realized that culture is more important than language") but also learned many specific (both the "big-C" and the "little-c" culture) aspects of Chinese culture. These aspects included: parenting, the hierarchy of the average Chinese family, marriage, dating, education, gift-giving etiquette, censorship in China, suburban life in China and the housing problem, how the younger generation is encouraged to interact with older generation, real Chinese cuisine, education, university life in China, hospitality when there are guests, use of kinship terms among familiar and unfamiliar people, visiting and dining etiquette, how familiar people greet each other, and so on. For example, some students wrote in their reflection papers that they had learned that, "people don't open gifts in front of each other in Chinese culture," "foods are often cooked more than a family could eat when they invite guests to home," "hosts are very amiable to their guests." These cultural aspects were not limited to what the video clips refer to, because students learned a great deal from the online discussion and the ethnographic interviews as well. In short, using the words of one of the participants, the culture project "changed the way I usually think about Chinese culture and gave me an opportunity to explore new knowledge about Chinese culture that I have not yet known."

*Second, the learners achieved a more comprehensive understanding of Chinese culture and partially improved their previous understanding about China***.** The implementation of the approach has re-enforced their cultural understanding. It made them more aware of some aspects of Chinese culture that they thought that they knew before, but didn't understand correctly. It also "connected dots" and helped them gain a better understanding of the target culture.

In addition, by exploring and learning about Chinese culture via this culture project, some students had changed their previous perceptions of China. One student wrote, "[doing the culture project] helped clear up some of the stereotypes Western culture often associates with China." The approach has also changed some perceptions of Chinese communication that the students had. For example, one student said that he learned that some things he considered to be rude and strange in Chinese culture were actually very normal and acceptable there.

Third, the learners noticed the differences between their own culture and Chinese culture. Students started to think about how Chinese culture relates to theirs. Most important of all, half of the participants started to realize that there were more similarities than differences. One student said, "[M]y Chinese friends are not very different from my American friends. They just have a language barrier." "I learned that my culture has a lot of similarities with the Chinese culture." "Interactions between family and friends are really similar except for the titles we give each other." "It changed my view on the culture of people that's different than mine. I've always thought that since we're so far away from each other, our culture will be the complete opposite, but it turns out we share some of it." "I feel that it changed my perspective on other cultures. I realized that Asian cultures aren't all that different from us, like most people think."

Fourth, the learners' understanding of people from different cultures has expanded, and they have become more reflective. Four students specifically pointed out that they understood people from the other culture more and that they respected people from other cultures more. The project helped them reflect more on why Chinese people do some things differently from Americans, which has helped them respect and appreciate their culture more. Some students thought that they unfairly judged some of their Chinese friends for doing things that turned out to be normal in the Chinese culture. Through the face-to-face interaction with NS, some students learned not to judge Chinese people just from what they have learned on social media. The approach helped them to have a world-wide perspective and learn the importance of other cultures on their lives. As a result, students have become more open-minded and their "world was broadened a little bit more." They learned to become "more accepting of other people's viewpoints and opinions" and "more receptive of how people act, interact and the effects of history on people's culture today." Their interests in learning more about the Chinese culture has increased. For example, one student wrote that doing the culture project had made her "fall in love with China" and made her "even more excited to go back to China this summer."

*Fifth, the learners have learned how to interact with people from another culture and become more confident of their future interaction with them***.** Five students mentioned that they learned how to conduct a proper interview and learned how people from China interact with each other. They found that the interaction between Chinese people in the videos was interesting. Additionally, they learned how to strengthen their connection with their Chinese friends and their own classmates. After finishing the culture project, students had learned many social-interaction related manners, such as what the proper things to do inside a Chinese home are, what they should expect from their culture in social interactions, and how to address friends in China. As a result,

students felt that they became "more comfortable with their interactions with people from China or Taiwan."

*Sixth, the learners learned a method for culture learning, and the project was regarded as a starting point for a more systematic way of learning culture***.** Six students mentioned that they had learned methods of learning about another culture and had "become more conscious of the cultural environment." They planned on taking Chinese culture courses, watching micro-movies that could be found on the Internet, making more Chinese friends, watching the classical films pointed out by the instructor, and traveling to China someday.

Overall, the implementation of the approach deepened the students' understanding of Chinese culture and positively impacted their attitudes towards people from the culture and their interests in the language. This effect was achieved not by one or two phases or by one or two components of this approach, but through the integration of all the phases and components. However, it is still crucial to know which components of the approach were regarded as the most helpful in improving their culture learning and which components could be improved to be more beneficial in the future implementation.

Among the components of the three phases, the ethnographic interview was regarded as the most helpful. In the students' words, the ethnographic interview was a "1 on 1 with culture" which has allowed them to meet "awesome new people," "really gets you personally acquainted," gives them "a chance to find out more about Chinese culture from a primary source," and helps them "get a lot of information that one wouldn't have got in a classroom." In addition, the interview allowed the students to clarify and become informed about the areas of Chinese culture they knew least about.

Another highly regarded component was watching the instructor-selected and edited movie/film clips. Most students felt that they were given the best resources to work with and the videos highlighted many cultural differences. The reason that the movie/film clips were enjoyed included: 1) they were "short and cute" and easy to understand; 2) they were modern and reflected today's life, like modern documentaries, which gave them "a look at what today' life would be like;" 3) students were directed to pay attention to the critical cultural issues through the edits that the instructor made and the questions students had to answer. The edits "ensured proper learning from the video and discussion" and helped students realize how different cultures were; 4) each of the selected movie and film clips has a story in itself that provided good information about what was happening and the students did not get lost easily.

Out of the three movie/film clips, the micro-movie "*Mother*" was identified by some students as their favorite. There were two reasons. First, the theme of the movie focuses on familial ties, and the students could relate this aspect to their own experience. Second, the artistic or aesthetic qualities attracted their attention and left space for them to contemplate. One of the artistic qualities, for example, was the unspoken things that provoked audience members' thoughts and emotions, such as the black and white photograph of a mother. Students appreciated the questions about the movie/film clips,

because those questions helped them "get more out of the culture project" and "analyze the video and go deeper into the "why" aspect."

The online discussion was also popular because it allowed students to interact with their peers and discover their perspectives on Chinese culture. Students liked that "everyone pointed out something different" and that others "had good viewpoints that made me reconsider mine or brought new ideas to light." In addition, they enjoyed learning about other cultures by reading posts made by their peers, sharing thoughts with people from other cultures, and learning more about the Chinese culture and another culture, such as Puerto Rican or Vietnamese culture.

Another component that most students liked was the writing activity, including the interview report writing and the reflection writing. "I liked write ups, as they condense knowledge," said one student. Reflection writing was especially appreciated because it helped "realize self-growth through the reflection paper" and it "really helped me understand my findings from the whole project and made me realize that when I go back to China this summer I want to learn and pay more attention to the Chinese culture." See Figure 13.

Figure 13 Participants' perceptions of the different components of the approach

Despite the fact that students generally enjoyed the culture learning approach and improved in many aspects, there are aspects that the students did not like. For example, some students were not satisfied with the length and number of film clips available for this culture project. Seven students commented that the film clips could be longer. Three students would have liked to have more than three video clips to watch. However, there was disagreement regarding the amount of information provided on the film clips. Two students suggested having no subtitles so that the film clips could be more enjoyable. Another two students thought that more information in the subtitles would help them understand the film clips better.

Although almost all participants appreciated the ethnographic interview, four students mentioned that it was hard to find an interviewee within a short time frame. The most frequent reason for the difficulty was that they did not personally know someone from China or Taiwan. Furthermore, due to different personalities of students, one shy student had a hard time interviewing the NS because it was hard to start a conversation with a stranger. Another student found that the interview was a little bit awkward because he had never interacted with NS before. One student preferred that the interview be more in depth, which would require a longer time than most students could afford. This student wrote, "We did not go deeply in depth with culture differences with society and personal roles (as much as I would like). If the work (ethnography) was to be more personal (such as hanging out or staying over with the interviewee) then I could have learned more."

7. Discussion

The implementation of this culture learning approach that combines authentic multimedia materials and ethnographic interviews in a blended learning environment, designed upon the principles proposed by Kramsch (1993), helped achieve the goals of culture instruction (Tomalin & Stempleski, 1993; Stern, 1992). These goals include "to become more aware of conventional behavior in common situations in the target culture, to develop the necessary skills to locate and organize information about the target culture, to stimulate students' intellectual curiosity about the target culture, and to encourage empathy towards its people" (Tomalin & Stempleski 1993:7-8). Stern suggests the additional goal of obtaining a research-minded outlook, affective goals, interest, intellectual curiosity and empathy (1992). After completing the culture learning project, students improved their cultural awareness of the "little c" culture that reflects the network of relationships, meanings, and shared expectations that bind people together into a culture, and their understanding of the differences and similarities between the Chinese culture and his/her own culture.

The approach also helped improve participants' awareness of culture learning resources, whether they be watching films or interacting with people from the culture. Furthermore, the ethnographic interview allowed students to be involved in conducting their own "research" by finding their own culture representative, setting up an interview with them, preparing for the interview, conducting the interview, analyzing the results of the interview, and writing up what they concluded from this research. The whole process enabled them to take a critical perspective and analyze the information they collected by conducting comparison and synthesis. During the process, they learned how to interact with people from a different cultural background. This approach helped the students learn ways to learn culture, conduct research and analysis, and develop a critical perspective. These skills will benefit them throughout their lives.

Participants' attitudes towards the community of people who speak Chinese also improved, and their interest in learning the Chinese language increased. The participants gradually came to understand some of the behaviors of the people from the target culture that they had not been able to understand before. This also inspired them to continue learning about and interacting with the Chinese culture in the future. The suggested

approach gives students access to the cultural realities that embedded in the Chinese language so that they can better understand better how words refer to culturally determined concepts. This increased interest in learning the language and the culture could help retain persistence in learning Chinese despite the challenges participants may face in the future (Seelye, 1993).

Most importantly, from a perspective of instruction, the successful implementation of the approach and the positive results of using this approach have shown that guided culture learning can happen in the online and blended learning environment without reducing precious FTF classroom instruction time. Instructors can use the FTF meeting time for language learning and communicative practice. It is true that the FTF language learning process should also be culturally loaded. However, to learn much about culture, students should have opportunities to focus on learning culture and culture learning methods. With the approach outlined in this manuscript, students can enjoy learning culture while still focusing the FTF meeting times on language learning. When instructors have limited FTF meeting time to teach culture (Seelye, 1974, 1993; Paige, et al., 2003), the approaches suggested by this research offer teachers alternative venues and platforms for teaching culture to their students.

The sequence of the approach also worked well. Watching edited film clips gives students a second-hand channel to learn "little c culture" in China. With the questions to answer, the students needed to go back to the film clips for at least a second viewing when they needed to focus their attention to the culture. Therefore, watching film clips with specific questions in mind adds another layer to understanding the plot in order to understand the important aspects in personal interactions where the culture lies. Furthermore, their understanding about the culture was clarified and deepened by getting their peers' perspectives in the online discussions and then from the whole class discussion.

After the second-hand input of culture, students might want to learn more about the target culture or might have questions about the other aspects of the culture. That makes it the right time for them to have the real contact with their peers from China. During the interaction process, i.e. the ethnographic interviews, they learned more about this culture. Through reflection, they reflected upon what they had learned, what could improve their learning, and their plans for the future in terms of culture learning.

Although the approach is successful, it can be improved. For example, to maximize learning, movie editing and movie choices could be more differentiated. More than three film clips could be used, with different lengths and plot complexities. Perhaps a fixed number of film clips would be required and the rest would be optional. The film clips could also be categorized into different cultural dimensions, such as values, relationships, customs, and taboos. For example, students may be required to choose one clip from each category. Furthermore, film clips can provide options for turning the subtitles and explanations off or on. More advanced students can choose to turn off the captions and explanations. Less advanced students can turn on the captions and explanations as needed.

8. Conclusion

This is the first study in the literature to examine the effectiveness of an approach that combines authentic multimedia materials, ethnographic interviews, and a blended learning environment on students' culture awareness, interests in the language learning, and attitudes towards the community of native speakers of the target language. The analysis is also the first to examine students' perception of such an approach. It demonstrates a number of strengths, such as using mixed methods in collecting rich data, and using design-based research to test the feasibility and effectiveness of the approach.

That said, the study also has its limitations. For example, even though the study used Gardner's (1985) survey (with modification) along with another survey to test the effectiveness of the approach, other methods also exist for testing the effectiveness of the method, such as asking for student responses to culture scenarios. Another method is interacting with NS using the culture about which they learned. These methods might be able to maximally test whether the students have improved in their cultural awareness or not. However, they are time-consuming and may be difficult to integrate into beginning language courses. In addition, before using these methods, we may need to fill in the gap between being students' cultural awareness and their ability to translate that awareness into a complex web of cultural behaviors and interactions as practiced in the target culture.

This study was an important first step in designing and testing an approach to teaching culture in a blended learning environment. Clearly, additional research and trials would expand the limited empirical base on this topic. In addition, a systematic development of a culture curriculum that might inform the uses of cultural learning in blended courses and engage NS as peer informants more fully, particularly in beginning language courses, is still urgently needed.

References

Allen, L. Q. (2000). Culture and the ethnographic interview in foreign language development. *Foreign Language Annals, 33*(1), 51-57.

Angelova, M., & Zhao, Y. (2014). Using an online collaborative project between American and Chinese students to develop ESL teaching skills, cross-cultural awareness and language skills. *Computer Assisted Language Learning, 29*(1), 167-185.

Arries, J. F. (1994). Constructing culture study units: A blueprint and practical tools. *Foreign language annals, 24*, 523-534.

Barro, A., Byram, M., Grimm, H. H., & Roberts, C. (1993). Cultural studies for advanced language learners, in D. Graddall, L. Thompson, & M. Byram (Eds). *Language and culture* (pp. 55-70). Clevedon, England: British Association of Applied Linguistics.

Boud, D., Keogh, R., & Walker, D. (1985). Promoting reflection in learning: A model. In R. Keogh, D. Walker, & D. Boud (Eds.), *Reflection: Turning experience into learning* (pp. 19–40). New York: Kogan Page.

Brown, S. K. (2010). Popular films in the EFL classroom: Study of methodology. Procedia – *Social and Behavioral Sciences, 3*, 45-54.

Byram, M. (1997). *Teaching and assessing intercultural communicative competence*. Clevedon, U.K.: Multilingual matters.

Byram, M. (2014). Twenty-five years on – from cultural studies to intercultural citizenship. *Language, Culture and Curriculum, 27*(3). 209-225.

Chapelle, C. (1998). Multimedia CALL: Lessons to be learned from research on instructed SLA. *Language Learning & Technology, 2*(1), 21-39.

Damen, L. (1987). *Culture Learning: The fifth dimension in the language classroom*. Boston: Addison-Wesley.

Desai, S. V., Jabeen, S. S., Abdul, W. K., & Rao, S. A. (2018). Teaching cross-cultural management: A flipped classroom approach using films. *The International Journal of Management Education, 16*(3), 405-431.

Dewey, J. (1933). *How we think: A restatement of the relation of reflective thinking to the educative process*. Boston: D. C. Heath.

Fenner, A. B. (2000). Cultural awareness. In A. B. Fenner & D. Newby (Eds.), *Approaches to materials design in European textbooks: Implementing principles of authenticity, learner autonomy, cultural awareness* (pp. 142-152). Graz: European Centre for Modern Languages.

Guthrie, K. L., & Bertrand Jones, T. (2012). Teaching and learning: Using experiential learning and reflection for leadership education. In K. L. Guthrie and L. Osteen (Eds.), *New directions for student services No. 140* (pp. 53–64). San Francisco, CA: Jossey-Bass.

Graham, C. R. (2006). Blended learning systems: Definition, current trends, and future directions. In C. J. Bonk & C. R. Graham (Eds.), *The handbook of global learning: Global perspectives, local designs* (pp. 3-21). San Francisco: Pfeiffer.

Graham, C. R., Allen, S., & Ure, D. (2003). *Blended learning environments: A review of the research literature*. Unpublished manuscript.

Graham, C. R., Allen, S., & Ure, D. (2005). Benefits and challenges of blended learning environments. In M. Khosrow-Pour (Ed.), *Encyclopedia of information science and technology* (pp. 253–259). Hershey, PA: Idea Group.

Grgurović, M., & Hegelheimer, V. (2007). Help options and multimedia listening: Students' use of subtitles and the transcript. *Language Learning & Technology, 11*(1), 45-66.

Hatcher, J. A., & Bringle, R. G. (1997). Reflection: Bridging the gap between service and learning. *College Teaching*, *45*(4), 153–158.

Hickey, L. (1980). Ethnography for language learners. *Foreign Language Annals, 6*, 475-481.

Morain, G. (1983). Commitment to the teaching of foreign cultures. *The Modern Language Journal, 67*, 403-412.

Kern, R. (2000). *Literacy and language teaching*. Oxford: Oxford University Press.

Kern, R. (2015). *Language, literacy, and technology*. Cambridge, UK: Cambridge University Press.

Kim, S. Y., & Weber-Fève, S. (2015). An interview with Stacey Weber-Fève, Iowa State University: Creating language teaching through film and literature: Creating

connections. *The Korean Language in America, 19*(1). 84-101. Retrieved from https://lib.dr.iastate.edu/language_pubs/173

Knouse, S. M., & Abreu, L. (2016). Using Pinterest to facilitate the learning of culture. *The NECTFL Review 77*, 15-51.

Kolb, D. A. (1984). *Experiential learning: Experience as the source of learning and development.* Englewood Cliffs, NJ: Prentice-Hall.

Kramsch, C. (1993). *Context and culture in language teaching*. Oxford: Oxford University Press.

Kramsch, C. (1999). Teaching text and context through multimedia. *Language Learning & Technology*, 2(2). 31-42.

Kramsch, C. (2009). *The multilingual Subject: What foreign language learners say about their experience and why it matters*. Oxford: Oxford University Press.

Kress, G., & van Leuwwen, T. (1996). *Reading images. The grammar of visual design*. London: Routledge.

Newton, J., Yates, E., Shearn, S., & Nowitzki, W. (2010). *Intercultural communicative language teaching: Implications for effective teaching and learning - A literature review and an evidence-based framework for effective teaching*. Wellington, NZ: Ministry of Education.

Oakley, G., Pegrum, M., Xiong, X., Lim, C., & Yan, B. (2018). An online Chinese-Australian language cultural exchange through digital story telling. *Language, Culture and Curriculum, 31*(2). Retrieved from https://doi.org/10.1080/07908318.2017.1386193

Paesani, K., Allen, H. W., & Dupuy, B. (2016). *A multiliteracies framework for collegiate foreign language teaching.* Upper Saddle River, NJ: Pearson.

Paige, R. M., Jorstad, J., Siaya, L., Klein, F., & Colby, J. (2003). Culture learning in language education: A review of the literature. In D. Lange, & R. M. Paige (Eds.), *Culture as the core: Integrating culture into the language education* (pp. 173-236). Greenwich, CT: Information Age.

Robinson-Stuart, G., & Nocon, H. (1996). Second culture acquisition: Ethnography in the foreign language classroom. *The Modern Language Journal, 80*, 431-449.

Rodriques, M. V. (2000). *Perspectives of communication and communicative competence*. New Delhi: Concept.

Ryshina-Pankova, M. (2015). Foreign language curriculum as a means of achieving humanities learning goals: Assessment of materials, pedagogy, and learner texts. In J. M. Norris & J. M. Davis (Eds.), *Student learning outcomes assessment in college foreign language programs* (pp. 222-246). Honolulu: University of Hawai'i, National Foreign Language Resource Center.

Ryshina-Pankova, M. (2018). Discourse moves and intercultural communicative competence in telecollaborative chats. *Language Learning & Technology, 22*(1), 218-239.

Sawffar, J., & Arens, K. (2005). *Remapping the foreign language curriculum: An approach through multiple literacies*. New York: Modern Language Association.

Schenker, T. (2013). The effects of a virtual exchange on students' interest in learning about culture. *Foreign Language Annals, 46*(3), 491-507.

Schulz, R. A. (2007). The challenge of assessing cultural understanding in the context of foreign language instruction. *Foreign Language Annals, 40*, 9-26.

Seelye, N. (1974). *Teaching culture: Strategies for foreign language educators.* Lincolnwood: National Textbook Company.

Seelye, N. (1993). *Teaching culture: Strategies for intercultural communication*. (2nd Ed.). Lincolnwood: National Textbook Co.

Spindler, G., & Spindler, L. (1987). *Interpretive ethnography of education: At home and abroad*. Hillsdale, NJ: Lawrence Erlbaum.

Stern, H. H. (1992). *Issues and options in language teaching*. Oxford: Oxford University Press.

Sun, L. (2013). Culture teaching in foreign language teaching. *Theory and Practice in Language Studies, 3*(2), 371-376.

Tomalin, B., & Stempleski, S. (1993). *Cultural awareness*. Oxford: Oxford University Press.

Thomas, D., & Brown, J. S. (2011). *A new culture of learning: Cultivating the imagination for a world of constant change.* Charleston, SC: CreateSpace.

Thorne, S. L. (2010). The "intercultural turn" and language learning in the crucible of new media. In S. Guth & F. Helm (Eds.), *Telecollaboration 2.0: Language, literacy, and intercultural learning in the 21st century* (pp. 139-164). Bern, Switzerland: Peter Lang.

Vygotsky, L.S. (1962). *Thought and Language*. Cambridge, MA: MIT Press. (Original work published in 1934).

Vygotsky, L.S. (1971) *Mind in Society: The development of higher psychological processes*. Cambridge, MA: Harvard University Press.

Yanguas, I. (2009). Multimedia glosses and their effect on L2 text comprehension and vocabulary learning. *Language Learning & Technology, 13*(2), 48-67.

Zhang, S. (2015). Using authentic multimedia materials and ethnographic interview to improve target culture learning: A preliminary proposal. *K-12 Chinese Language Teaching, 1*(1), 1-9.

Zhang, S. (2016a). Teachers as curators: Curating authentic online content for beginning and intermediate CFL learners. *Researching and Teaching Chinese as a Foreign Language, 2*(2), 181-193.

Zhang, S. (2016b). Learning through a CMC-based tandem project with native speakers: A descriptive study of beginning CFL Learners. *Journal of Technology and Chinese Language Teaching, 7*(2), 58-81.

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