On Computer and Foreign Language Teaching and Learning in Big Data Era

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Abstract—The aim of this paper is to explore the application of computer to foreign language learning in Big Data era. Combining the properties of language learning and teaching theories, we analyze the potential uses of computer in foreign language learning. We find that the main potential of computer-based foreign language learning lies in making authentic language resources accessible to learners, providing Big Data analysis for foreign language teaching and triggering the new online learning and teaching models. As for foreign language learning in Big Data era, we propose that the application of computer should be based on the learners' need and teachers' instruction.

Keywords—Computer; Foreign Language Learning; Big Data

1 Introduction

Nowadays, cloud computing, internet of things and social network have made data type and amount grow at high speed, which is making human society come into the Big Data era in which people are getting used to web-based activities such as shopping online, reading, writing, reviewing and communicating online. These web-based activities are realized by computer technology. Integrating technology into foreign language (FL) learning is always the trend, for learners prefer being engaged in the process of learning and have a more positive attitude towards learning [1]. The existing technologies such as televisions, videotapes and audiotapes have been available for use in FL teaching for at least several decades. Then, based on minor modification to previous similar technologies, the new technologies (e.g. DVD and CD players; digital slide presentation hardware or software) are applied in FL learning. With the popularity of modern network and information technology, the role played by computer has become outstanding in FL learning. It is reasonable to acknowledge that how to utilize the computer and network technology to develop online FL teaching and learning modes will be an important trend of FL teaching reform.

However, as for the integration of technology into FL learning, we must admit that although technological innovations can increase learner interest and motivation, provide organizing course content and interacting with multiple students, the use of new technology also can result in inappropriate input, shallow interaction, and inaccurate feedback, student frustration with software and hardware and distraction from the

learning task. Hence, in the Big Data era, it is worthwhile to probe into how to make effective use of computer technology in FL learning and avoid the deficiencies it may bring.

This paper aims to examine the enormous potential of computer in foreign language (FL) learning. Section 2 focuses on the present use of computer in FL learning and the relevant theoretical foundations. Section 3 explores the potential of computer in FL Learning in Big Data era. Section 4 presents the need-based and instruction-based use of computer in FL learning. The last section draws the conclusion.

2   Computer and FL teaching and learning

2.1   The use of computer technology in FL teaching and learning

Since its birth, the application of computer has been recognized in the field of FL learning. At the initial stage, computer is applied to FL learning by playing the assistant role just as other technologies (i.e. televisions, videotapes and audiotapes) do. Until now, computer-assisted language learning (CALL) has been a subject of investigation for over 30 years. Chen [3] held that computer is moving gradually from assistance to autonomy in foreign language teaching. He further pointed out that the development of artificial intelligence, digitization and information technology facilitates computer autonomous language teaching which will make it possible to conduct cooperative, individualized teaching in a virtual situation.

The ability of the computer to collect, store, retrieve, and analyze huge amounts of data lays the foundations for Data-Driven Learning [4]. At the early stage of behaviorist language teaching, restricted-focus drill-based software [5] was used to make language learners practice some language elements. As for the early application of computer in language learning, its weakness is also noticed. For instance, Bloch[6] deemed that early CALL (computer assisted language learning) software "tended to mimic the approaches used in traditional grammar teaching that used artificial sentences with the student having to provide the correct answers, which could be checked by the program". Later on, in the phase of communicative language teaching, computers are used to provide input for language acquisition in a more skill-balanced approach.

Nowadays, Big Data, as the trend of human development, has triggered the emergence of massive open online courses (MOOCs). MOOCs are a recent and widely researched development in distance education which was first introduced in 2008 and emerged as a popular mode of learning in 2012 [7]. Small Private Open Online Courses (SPOC), as a version of a MOOC is used locally with on-campus students. The word SPOC was coined by Professor Armando Fox in University of California Berkeley in 2013 to refer to a localized instance of a MOOC course. By taking MOOCs or SPOC, online learners can learn asynchronously, synchronously or autonomously. At present, flip teaching is growing rapidly in popularity in FL learning with blended learning now taking hold in computer-based contexts.

2.2 Theoretical foundations for computer use in FL teaching and learning

It is the computer-based technological innovations that bring us into Big Data era. Current trends in the field of foreign language teaching indicate a shift in pedagogical perspectives and theoretical frameworks, with student interaction at the heart of learner-centered constructivist environments. In fact, based on language pedagogical perspectives and theoretical frameworks, the history of computer-assisted language learning (CALL) can be divided into three periods: the 1960s–1970s (behaviourist CALL), the 1980s (communicative CALL), and the 1990s–present (integrative CALL) [8].

For simplicity, we summarize the theories which support computer use in education from two perspectives. The first is based on behaviourist learning theories and focuses on the computer as a mechanism to deliver information. So far, we have witnessed that the computer is having a major impact on the ways we interact with information and with each other. The second is based on constructivism and focuses on the computer use as a system to enhance teaching and learning, in order to exploit the versatility and uniqueness of computer-based technologies to help the teacher establish powerful environments for students' learning. Situating learning in an authentic context and being open to different perspectives has been identified as a major strategy through which computer technology can help teachers to enhance the scope and depth of pupils' language learning.

Besides behaviourist and constructivist theories, teaching design theories and learning theories are also involved in computer-based FL learning. For instance, the teaching model of flipped classroom are supported by the teaching design theories, constructivism and game-based learning theories (see [9]). Under such theoretical guidance, CALL began to test and explore the benefits of using the emerging technology tools such as wikis, blogs, and podcasts as well as social software applications to foster student interaction in online language learning and promote collaboration in both synchronous and asynchronous learning environments (e.g. [10] [11]).

3 Major potential of computer in FL learning in Big Data era

This section probes the major pedagogical potential and imperatives of using computer in FL learning. The main potential of computer-based FL learning lies in the accessibility of authentic language resources, Big Data analysis in FL teaching as well as the new online learning and teaching models such as network autonomous learning, blended learning, flip teaching, Moocs, SPOC and etc.

3.1 Accessibility of authentic language materials

From sociocognitive perspective, language use and learning should be acquired in certain circumstances which involve authentic language materials and context. In fact, just in the consideration of the biological and sociological properties of human languages, language teaching has been always attempting to provide authentic language materials to learners and construct the authentic language learning environment.

Nowadays, this attempt can be better achieved for computer technology provides not only the authentic language materials but also an authentic language context in which the target language is used in a naturalistic setting.

According to Pennington [12], computer has the potential for enhancing language learning by the unique properties and variety of the language input. Table 1 summarizes the features of the expanded language input offered by computer. Such language input guarantees that learners can easily access the authentic language materials and are familiar with the naturalistic settings in which the target language is used.

Table 1. Expanded language input offered by computer

Quantity of input	Enlarged pool of potential input
Access to input	Enlarged language learning context
Diversity of input	Increased variety of input
Sources of input	New sources of information and partners for interaction
Quality of input	Focused, individualized, salient, authentic input
Novelty of input	Qualitatively new ways of accessing information

From the above table, it is evident that the computer technology has greatly broadened the scope of FL learners' language input beyond the curriculum and has thus given them more latitude to pursue their personal interests. However, the availability of information alone will not automatically turn into actual learning. This is where teachers' pedagogy should come into play:

3.2 Accessibility of the new online FL learning means

Computer not only makes the diversity and variety of language input available but also offers new sources of information and partners for interaction such as by email, Internet browsing and chat activities, etc. Language learning involves interaction with input and with people. Computer just provides us the means and patterns on which the new network-based learning models are built, these learning means can be illustrated in Table 2:

Table 2. Computer-based FL learning means

Chat	A form of synchronous computer-mediated communication
Social networking	Social networking enables peer-to-peer communication and collaboration.
Internet forum or message board	An asynchronous system in which messages are sent to multiple recipients.
Blog	A web application that displays entries authored by the blog owner and is visible to other web users
Wiki	A website that allows multiple users to post or edit information

Such communicative means enable communication and collaboration among language learners or between language learners and native speakers without constraints

of distance or location, allow for synchronous or asynchronous communications and encourage collaborative learning. All this increases language learning opportunities and learnability.

3.3 Accessibility of individual FL learning tools and devices

To facilitate language learning, the individual FL learning tools and devices are invented with the help of computer technology. The popular computer-based individual study tools in FL learning are electronic dictionary, grammar checker, automatic speech recognition (ASR) and pronunciation program, which are described in Table 3.

Table 3.   Computer-based FL learning means

Electronic dictionary	A dictionary in electronic form – either handheld or online
Grammar checker	A program designed to evaluate a written text's well-formedness in terms of grammaticality
Automatic speech recognition （ASR） & pronunciation program	A technology that allows a computer to identify the words a person speaks into a microphone.

Electronic dictionaries are more popular among present-day college students than traditional paper dictionaries in FL learning.

3.4 Accessibility of Big Data in FL learning analysis

With more and more software systems employed in education, there appears massive educational data. Educators have become concerned on how we could fully use the massive educational data and transfer the data into useful information and knowledge in order to make scientific educational decision and optimize instruction. Computer-based learning analytics is a typical analysis carried by big data methodology. According to the 2011 Horizon Report [13], learning analytics refers to the interpretation of a wide range of data produced by and gathered on behalf of students in order to assess academic progress, predict future performance, and spot potential issues. Learning analytics is used for realizing the value of learning process data.

At present, scholars have begun to realize that it's quite important to analyze loads of data used and generated in foreign language teaching. Based on a research report of 1, 093, 126 English writings on the same topic by Chinese EFL (English as Foreign Language) learners in 2015, Wang & Zhang [14] explored how Big Data methodology can help reinvent and reshape the teaching of EFL writing for achieving higher efficiency in teaching, stronger motivation in learning. By using Big Data methodology, they statistically analyzed learners' composition modification frequency and respectively gained scores, changes in the vocabulary and sentence, error types in writing etc. They held that Big Data methodology can bring innovation to English writing teaching; therefore, they advocated data-driven teaching to innovate the teaching of English as a foreign language in China. In short, depending on the particular data that the analysis is addressing, different data analytic methods and techniques can be used

to identify the value of data, optimize teaching and learning models, etc., so as to increase learning efficiency.

From the above two sections, we conclude that the application of computers is sustained by certain FL teaching & learning theories, which just inspire the potential of computer in FL teaching & learning. The following figure clearly illustrates the compatibility between FL teaching & learning theories and the potential of computer.
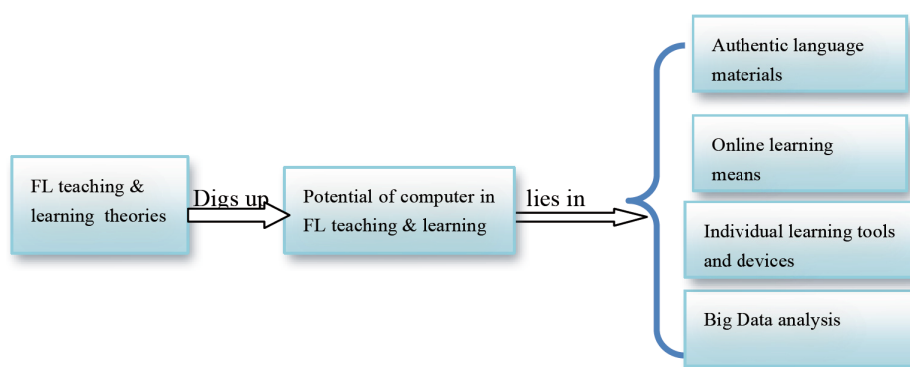

Fig. 1. A framework for understanding computer-based FL teaching and learning

4 The effective use of computer in FL teaching and learning

The development of computer technology makes a multitude of computerized resources and tools available to the possible needs of language learners. However, teachers' and learners' awareness of the pedagogical potential and imperatives of computer technology alone can be by no means a guarantee that such potential will be effectively used. Timothy Reagan (see [15]) argued that although new technology can assist language learning, it cannot be regarded as a cure-all because in some cases its abuse or misuse can make the learners frustrated in the learning process. To avoid such abuse or misuse, the application of computer to language learning should be based on the need of learners and the instruction of teachers. The need-based use of computer and the instruction-based use of computer ought to be regarded as the key guiding principles to sustain computer-integrated pedagogy in FL teaching, for these two principles can arouse learning enthusiasm and enhance language learners' autonomy over their learning.

4.1 Need-based use of computer

FL learning needs authentic input. Thus, Chen & Chen [15] suggested that in the language environment which is not ideal for learning a foreign language, learners should make full use of information technology and use it to dig amount of foreign language resources so as to make up for the deficiency of language learning environment. As for the English majors in China who value language communicative skills

and urgent needs for improving their academic writing and reading abilities, they can choose network-based communicative models in their learning such as online chat, social networking, internet forum or message board, blog, wiki and cloud-based writing software. In another case, Terrence G. Wile (2015, see [15]) online investigated over 1,600 English learners in China and found although these learners had strong learning motivation, they explicitly expressed that they lacked the learning opportunities, and most of them thought English speaking and listening were their weak points. For such learners, automatic speech recognition (ASR) and pronunciation program may be the best choice to improve their English speaking and listening ability.

The consideration of language pedagogy and assessment of learners' need would help make learning aims more compatible with the pedagogical capacity of computer. In short, it is worthwhile to probe into the effective means to connect the language theoretical construction with the application of modern educational techniques with considering learners' need in foreign language teaching practice.

4.2 Instruction-based use of computer

Tochon (2015, see [15]) held that the application of new technology to language teaching has side effect such as the health risk and mental stress on the learners, therefore, he warned that learners should not be imprisoned by technology. To avoid the side effect of computer technology, teachers should give more instruction on the application of computer to FL learning.

Liu & Li [16] investigated the learning needs of English majors and found that network has become a new channel used by students for learning English; however, network as a learning model is mostly used by students to collect materials for finishing their homework assignments, watch English films and listen to English music. Generally, the application of network in language learning lack scientific guidance. In grammar learning, Kılıçkaya [17] proved that participants instructed by using both computer-based and teacher-driven grammar instruction supported by computer-based materials score higher than those who receive traditional instruction. Furthermore, Kılıçkaya proved that teacher-driven instruction with computer-based materials in learning adverbial clauses can lead to higher achievement through taking practice beyond the classroom. Zheng, Niiya and Warschauer [9] also proved that although wikis are a promising platform for collaborative learning, wiki-supported collaborative learning cannot function without an effective learning design, and therefore, they suggested that well-designed instruction is vital to the success of any technology-facilitated learning activities in higher education.

Well-designed instruction of technology-facilitated learning activities depends on the teachers who use the technology in teaching. Thus, teachers' attitudes to computer technology and their corresponding abilities should be taken into consideration. That is, teacher education programs or teacher training is the obvious next step towards harnessing the pedagogical potential of computer technology. FL language teachers cannot be expected to become effective because technology-facilitated learning and teaching requires the skills and responsibilities different from traditional language teaching. More research needs to be done to identify these skills and responsibilities

in order to satisfy the needs of language learners. Future research, therefore, should focus on teachers' perspectives and practice with computer technology, especially, language teacher training should be taken into consideration as an essential variable.

5 Conclusions

We have analyzed the use of computer technology in FL learning and the corresponding theoretical foundations for computer use in FL teaching and learning through review of previous studies. By analyzing the major potential of computer in FL teaching and learning in Big Data era, we concluded that the effective use of computer in FL teaching and learning is based on the need of students and the instruction of teachers. This can be illustrated in Figure 2.

This framework demonstrates how transforming FL teaching and learning with computer use requires not just computer technology, but also pedagogy as well as a more systemic instruction for sustaining the transformation of FL teaching and learning with computer use. Computer has the built-in features for supporting FL learning in Big Data era. However, the use of computer technology alone does not guarantee successful learning activities. Pedagogical design for integrating technology into FL learning is important, especially, in network-based learning activities. Well-designed instruction is vital to the success of computer-based learning.

By applying fundamental principles of language learning, future research should address the affordances that computer can make for FL teaching and investigate the specific characteristics of computer-based technologies that may have differential effects on mastering the language skills (such as speaking, listening, reading and writing).
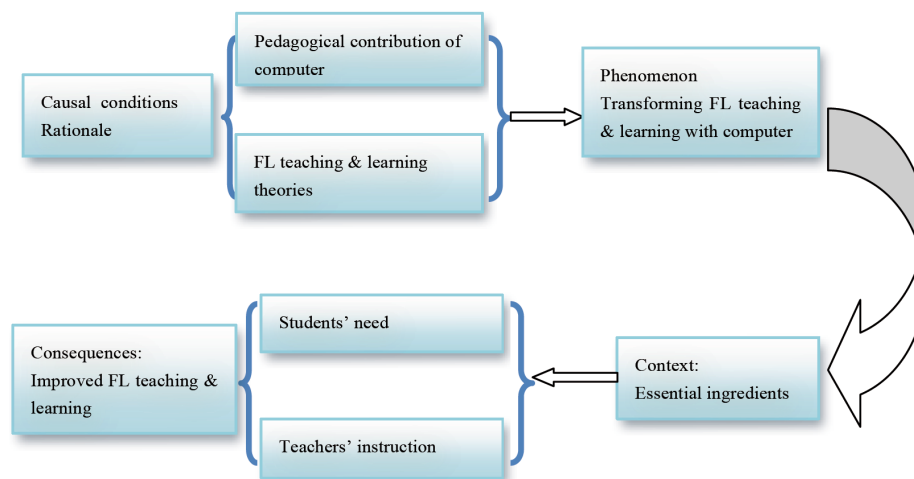
Fig. 2. A framework for understanding transformation of FL teaching and learning with computer use

6 Acknowledgment

This research is supported by Hubei Provincial Department of Education in China under Grant No.2015GB173.

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