Shih, JL. et al. (Eds.) (2023). Proceedings of the 31st International Conference on Computers in Education. Asia-Pacific Society for Computers in Education

Enabling Visually Impaired People's Chinese Literacy learning through Information Technology

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Abstract: How to help the visually impaired people in Taiwan to be able to learn Chinese literacy online has been a big challenge. However, in order to overcome the obstacle, we intentionally designed and implemented a cloud-based Visually Impaired People (VIP) E-learning Platform that affords to empower their Chinese literacy learning via specific typing skills and relevant course design so that they would have the opportunity to become independent online navigators and learners as well. To facilitate and examine their performance in terms of typing accuracy and speed on the Chinese typing and information searching online, etc., a competition activity was organized. Both quantitative and qualitative data were collected and analyzed via a questionnaire administered to the 18 participants, divided into three groups based on their ages. The results indicate that overall the participants are highly satisfied with the VIP platform for its empowerment in Chinese literacy learning that affords their online independent learning opportunity and barrier-free communication skills with sighted people after using the VIP platform. Additionally, some suggestions for the VIP platform improvement were given by the participants to achieve a more user-friendly and better online learning environment in the future.

Keywords: Visually impaired people, e-learning, typing competition, Chinese literacy

1. Introduction

A computer-based multimedia learning environment is one of the most commonly used ways of learning nowadays. Multimedia learning emphasizes not only the use of visual aids but also auditory aids to improve learners' learning and understanding (Mayer et al., 2002). Moreover, multimedia tools can be effective aids to the research consent process under some circumstances (Palmer et al., 2012).

However, for those who are visually impaired, the abundant visual aids provided by Multimedia are almost ineffective. The visual system is the main sensory source of human beings. Eight-seven percent of the total capacity of the brain process visual information (Hsieh, 2014). The limited channels for the visually impaired to understand and learn about the world is listening and tactility.

Providing equal learning opportunities for those who are visually impaired is getting more and more attention nowadays. Educational service organizations around the world have begun to provide online learning courses and digital learning resources for those visually impaired.

A university and an organization in Taiwan have jointly committed to the development of a cloud-based Visually Impaired People (VIP) E-learning Platform based on the scaffolding theory and Web Content Accessibility Guidelines (WCAG) 2.0 to help the visually impaired to learn online by using computer typing since 2016. It is hoped that through long-term research and promotion, the visually impaired could learn to benefit from this platform.

Therefore, given the length of the manuscript, this paper does not report the VIP system. Rather, this paper aimed to exam the potential of the visually impaired in Chinese typing and information searching through the competition results and questionnaire analysis. The following would be the research questions.

1. What was the participants' engagement in terms of frequency of practicing, time spend, and frequency of typing the same materials?
2. How did visually impaired learners feel about using the VIP E-learning platform, in terms of advantages and the needed improvement?
3. What would be the performance of those participants in term of typing accuracy and speed on the Chinese typing and information searching competitions?

2. Literature Review

2.1 Computer-based Multimedia Learning

Learners who receive information mainly via both auditory and visual channels simultaneously can absorb more sensory information, retain more memory, and increase their problem- solving ability (Mayer, 2005). Besides, learners can take advantage of five aids of multimedia to improve the effectiveness of learning, such as multimedia aids, contiguity aids, coherence aids, modality aids, redundancy aids in the computer-based learning environment (Mayer, 2002). However, apart from Modality aids, none of the other four seem to apply to the visually impaired since the other four rely on the visual aids. Moreover, the web pages nowadays consist of a large number of animations, special effects, or pictures that so- called multimedia, but no matter how attractive the visual aids are, the visually impaired still cannot benefit from them (Lin, 2003).

2.2 The Challenges for the Visually Impaired people in Typing Chinese

Contacting people and searching for information on the Internet using computer typing is undoubtedly a common activity and necessary skills for people living in the information era. For the visually impaired, computer typing is the main way for them to do text communication (Wang et al., 2014). However, the visually impaired encounter difficulties in typing in Chinese, such as the homophones with different meanings and the unavailability to check the correctness of words. Compared with English alphabetic systems, vocabulary is composed of letters and the pronunciation is basically as shown in spelling. For example, both "Male" and "Mail" are pronounced as "[meil]," and both "Whole" and "Hole" are pronounced as "[houl]." The spelling of the English words differentiates based on the context, but can be determined if the word is correctly used or not. On the other hand, Mandarin Chinese belongs to the logographic system, in which symbols represent the words themselves, and many words with homophones but different meanings are common. For example, both expectation (期待)and Umbilical cord (臍帶) are pronounced as "qídài" in Mandarin Chinese; both stray and elk are pronounced as "mílù" "ㄑㄧˊㄌㄨˋ"; both stray (迷路) and elk (麋鹿) are pronounced as "mílù" "ㄇㄧˊ ㄌㄨˋ" in Mandarin Chinese but their meanings are different. This phenomenon will cause difficulties in computer text communication with a group of people and searching information on the Internet. In addition, the visually impaired cannot immediately distinguish the correctness of words by "seeing" when typing, so typing with typos is a common phenomenon (Wang, 2014; Weng, 2015).

3. Methodology

3.1 Introduction to the Competition

The competition for the visually impaired on Chinese typing and information searching was jointly organized by Taiwan Digital Talking Book Association (TDTB) and Graduate

Institute of Learning Sciences and Technologies, National Tsing Hua University, and sponsored by the foundation of Elite-well. The competition included two sections, Mandarin Chinese typing and information searching. In order to assure the competition quality, typing speed of at least 15 Chinese characters per minute is minimally required for the participants.

3.2 Rules for the competition

In the Chinese typing section, participants were given 10 minutes to type an article selected by the organizers with at least 1000 words presented via the NVDA report in the Mandarin Chinese twice, the higher record would be the final score. As long as the time is up, the VIP system will automatically stop and display the typing speed and accuracy. The difficulty of the selected articles encountered by the three groups of students in the competition increases according to their age.

In the information searching section, participants proceeded 20 minutes to search the correct answers to the designated questions designed by the organizers on the Internet and submitted the resource link. The difficulty of the questions encountered by the three groups of students in the competition increases according to their age. The more correct answers would win the competition.

The two sections of competition aimed to cultivate participants' skills of computer operation and typing ability for further facilitate self-learning and satisfying career requirement.

3.3 Participants

The participants of this research are 18 people who participated in the typing competition for the blind on November 21, 2021. Their age ranges from 10 to 41 years old; education level ranges from elementary school to college or above.

3.4 Groups

1. Elementary school (under 12 years old): 2 participants with one male and one female
2. Junior high and senior school (13-18 years old): participants with 5 males and 3 females
3. Adult (above 18 years old): 8 participants with 4 males and 4 females

3.5 Four Phrases of this study

1. Preparation of competition materials, including selected articles for typing, and web searching questions
2. Questionnaire design
3. Competition: Chinese typing and information searching
4. Data collection and analysis

3.6 Research Methods

This research adopted mixed research methods, including both quantitative and qualitative approaches. The quantitative data were collected through the competition results of both Chinese typing and information searching and the questionnaire based on the 5-Point-Likert-Scale questions. The qualitative data were collected through the open-ended questions in the questionnaire, which was used to investigate the advantage and disadvantage of the VIP platform.

The questionnaire used in this research is designed with the Likert five-point scale to investigate the participants' perception to the VIP platform, which was distributed after the end of the VIP typing competition on November 21, 2021.

3.7 Questionnaire analysis

Among the questionnaires returned, the valid questionnaire is 18. The following section would address research question 1: What is the participants' engagement in terms of frequency of practicing, time spend, and frequency of typing the same materials?

1) Frequency of Practicing the Typing materials Per Week on the VIP platform

As shown in the Figure 1, among the 18 participants, 9 people use the VIP E-learning platform once or twice a week, accounting for 50% of the overall; 5 people watch the course 3-4 times a week, accounting for 28% of the overall; one person didn't watch the course every week, accounting for 5% of the total; 3 people who have never watched the course, accounting for 17% of the total.

2) Time on Each Chinese Typing Practice on the VIP Platform

As shown in the figure 2, among the 18 participants, 4 had never practiced, accounting for 22% of the total; 5 had practiced for 10-20 minutes each time, accounting for 28% of the total; 4 had practiced for 30-40 minutes each time, accounting for 22% of the total; 3 people practice 50 minutes to 1 hour each time, accounting for 17% of the total; 2 people practice more than 1 hour each time, accounting for 11% of the total.

3) Frequency of Course Review on VIP Platform

As shown in Figure 3, among the 18 participants, 13 have never reviewed, accounting for 72% of the total; 2 have reviewed once a month, accounting for 11% of the total; 2 have reviewed twice a month, accounting for 11% of the total; 1 only watch the course two weeks before the game, accounting for 6% of the total. Two reasons for the high number of never reviewers are:

1. They only use the platform as a place to practice typing.
2. They don't have time to review due to busy schoolwork or extracurricular activities.

The following sections would address the research question 2: How do visually impaired learners feel about using the VIP E- learning platform, in terms of advantages and the needed improvement.

4) Satisfaction of Using VIP Platform

Eight satisfaction questions are provided in the form of the 5- point Likert scale. As shown in Table 1, apart from the discussion forum and online consultation, participants are highly satisfied with the VIP platform.

Table 1. *Satisfactions of Using the VIP Platform*

Options	Mean	SD
Convenience of accessibility	4.33	0.68
Learning method	4.11	1.07
Exercises after each course	4.07	0.86
Videos, text files, slides, and extended information	4	0.9
Discussion forum	3.5	0.9
Online consultation	3.5	0.9
Listening and typing exercises	4.6	0.48
Exercise of information searching	4.22	0.73

5) Advantages of VIP Platform

The advantages of the E-Learning platform can be classified into two categories based on the results of the questionnaire, including the platform operability and the practicality of learning content.

First, platform operability. Except from the elementary school group, 3 participants in junior & senior high school group and four participants in the adult group think the VIP platform provide a simple interface and easy to use, accounting for 39% of the total. For example, J2A: "This website is accessible, easy to operate, and easy to use." C8C: "This website provides a simple interface and is easy to use."

Second, practicability of learning content. Forty-four percent of the participant are satisfied with the practicability of the learning content to empower them to type accurately,

accounting for 44% of the total. For example, E1A: “I become more familiar with the keyboard when operating a computer.” S1A: “I can practice typing speed and accuracy on the website.” J6A: “It can let the learners themselves know which words they type are incorrect, and allow those who are visually impaired know what the word means.” Three did not provide advice, accounting for 17% of the total.

6) Needed Improvements of the VIP Platform

The needed improvements can be categorized into three categories: information searching materials, interface of the VIP platform, and functions of the VIP platform.

First, information searching materials. Participants recommended to make the searching easier for Junior and Senior high school group.

Second, interface of the VIP platform. Participants recommended to add the automatic login function, improve the quality of online consultation, shorten the website URL of the VIP platform, make the whole webpage into the situation that the screen reader can read the words out.

Third, functions of the VIP platform. Participants recommended to classify the learning content according to difficulty, proofread the typos in the listening and typing articles, and update the article in a timely manner.

7) Competition Results

The competition was composed of two types of skills, including Chinese typing and information searching. Because typing with a high error rate will cause difficulty in communication or misunderstandings, the requirement for the error rate of the best typing record must be less than 6%.

First, Chinese typing competition. As shown in the Table 2, the best typing record in the Elementary school group is 430 words in 10 minutes, with an average of 38 words per minute and an error rate of 4%. The best typing record in the Junior & Senior high school group is 411 in 10 minutes, with an average of 36 words per minute and an error rate of 4%. The best typing record in the Adult group is 813 words in 10 minutes, with an average of 79 words per minute and error rate of 1%. Although JS1 in Junior & Senior high school group can type 698 words in 10 minutes with an average of 60 words per minute; and A1 in Adult group can type 1039 words in 10 minutes with an average of 86 words per minute, due to their 6% error rate, neither of them won.

Based on the Techficiency Quotient Certification (TQC) for Chinese typing, the Chinese typing speed can be divided into three levels according to the average typing speed per minute: Practical level: 15-29 characters per minute with the error rate less than 10%; Advanced level: 30- 79 characters per minute with the error rate less than 10%; Professional level: over 80 characters per minute with the error rate less than 10%. As we can see from Table 2, the best record for the Elementary group and the Junior & Senior high school group can reach to the advanced level. Besides, the best record in the adult can achieve to the professional level. Therefore, by diligent practicing on the VIP platform, the visually impaired can even perform better than those who are not visually impaired.

Second, information searching competition. The difficulty of the information searching differentiates depends on the age of each group. As shown in the Table 3, the best record in the Elementary school group can search 9 correct answers in 20 minutes. The best record in the Junior & Senior high school group can search 10 correct answers in 20 minutes. The best record in the adult group can search 6 correct answers in 20 minutes.

Searching information through the Internet is a necessary skill nowadays, by practicing on the VIP platform, the visually impaired are empowered to have the ability to search information.

Table 2. *The best record for each group in Chinese typing*

Group/Numbers of participant	Winner	Total	Error rate	Average typing speed
Elementary school/2	E1	430	4%	38 words/min.
Junior & Senior high school/8	JS2	411	4%	36 words/min.
Adult/8	A2	813	1%	79 words/min.

Table 3. *The best record for each group in information searching*

Group/Numbers of participant	Total
Elementary school/2	9/15
Junior & Senior high school/8	10/18
Adult/8	6/20

4. Conclusion

The results of this study indicate the effects of the modality aids proposed by Mayer. The online platform could benefit those VIP and they are highly satisfied with the VIP platform. Their performance on the typing speed and accuracy are outstanding and impressive. When the visually impaired is continuously practicing on the VIP platform, they can gradually reduce the typing error rate, which not only allows them to strength their information searching and communication skills, apply for jobs with this skill, but also reduces the inconvenience in communication with people in written language. Moreover, it is expected that the users on the VIP platform can take the advantage of this the practicing materials to achieve the self-directed learning on the Internet.

Acknowledgements

Thanks for the partial support from the Ministry of Science and Technology (MOST), R.O.C., under the grant codes: MOST 108-2511-H-007 -008 -MY3 and MOST 112-2410-H-007-0023, moreover, all of the participants involved in this study.

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