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Development of an Accessible E-learning Platform for Congenitally Visually Impaired Students Learning Chinese Computer Input Method

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Abstract
Unlike other alphabetic languages, Chinese is a pictogram language that implies visual messages. For congenital visually impaired students, it is often found that visually impaired students have lots of typing errors, which cause them difficulty in advancing higher education and searching for employment. It is imperative for the visually impaired students to have the Chinese Computer input skill in their written communication with other sighted people.
To bridge the gap, the web-based platform is under development in this study for visually impaired students to use the learning materials for learning Chinese computer input method. In addition to the learning materials of 25 video units, a self-assessment model, and learning process recorded data are provided for learners and teachers to keep tracks of the learner's performance in the platform. How we combine the concept of integrated education and the series of e-learning unit will be also described. Finally, we interviewed the visually impaired expert with years of teaching experience to assess the usability of this platform.
Keywords: Visually impaired students, e-learning, congenital blindness, Chinese input method, Web Accessibility

1. Introduction
With the advent of personal computers and the Internet, typing has become the most common method of input to access information and to operate a PC (Wang, 2007). But the frequent typos shown on entering texts by lots of visually impaired people are commonly found, which makes it difficult for sighted readers to understand their writing (Wang, Huang, Young & Chang, 2015). This in turn negatively affects their performance in school and future employment. This is due partially to the loss of their eyesight as well as the lack of sufficient information in the character description, and thus causing the blind to have difficulties when entering texts on a computer Chinese in selecting the right character from those candidates with the same pronunciation but different meanings (Weng, Hwang & Wang, 2014). The majority of the congenitally blind students in Taiwan are taught to type with Zhu Yin Input Method, which is a sound-based system. There are many characters that sound the same yet have very different meanings. As an example, there are a total of 249 Chinese characters pronounced the same sound as "Li" in Mandarin, but each character has varying meanings. Even with the support of powerful screen reader software, it is still difficult for the visually impaired person using Zhu Yin input method to distinguish the differences among listed candidate words.
In order to solve the foregoing problems, researchers (Wang, Weng, Hwang, Huang, & Young, 2015) apply the screen reader software specific features to develop a new instructional method, and teach visually impaired students with congenital blindness Boshiamy input method instead of the traditional Zhu Yin input method. Boshiamy is a kind of structured-based input method, which is comprised of about 300 Chinese radicals to build hundred thousands of Chinese characters, and radicals are mapped to 26 letters by their forms, sounds, or meanings (Wikipedia, 2014). It is considered to be suitable for visually impaired students to learn because of the characteristics affording low frequency of character selecting and easy to learn. An experimental instructional course was carried out during a period of nine months, and the results showed that the typing accuracy rates and speed of two subjects have significantly enhanced. This shows that teaching visually impaired students ware to learn Boshiamy input method is effective and feasible. However, previous instructional courses, were mostly given in the face to face manner, which is not convenient for both instructors and learners who are visually impaired to mobilize to the class. Therefore, there is a need to apply the mode of e-learning to provide those visually impaired with congenital blindness learning at home. More one we

first apply the Boshiamy input method as the pilot course. This study inherits the previous research results, according to the new web accessibility standards WCAG2.0 to developing an accessible e-learning system for congenitally visually impaired students. The importance of this study lies in the redesign of the courseware and the construction of the new e-learning platform for visually impaired students. Regardless of time and place restrictions, the target learners can access conveniently with a screen reader software online audio and video learning materials.

After watching each unit of learning material in the platform, an exercise is provided for the learner to practice. All the related data such as correct or wrong typing of characters during the learning and practicing period are recorded for later review by instructors or learners if necessary. Based on these recorded data, the instructor can assist the learner to improve his or her typing skill.

To verify the usability and accessibility of this platform, in this study we interviewed two visually impaired experts with years of teaching experiences.

The research questions underpinned are listed as follows:

1. Does the layout design of the platform facilitate the visually impaired to navigate?
2. Does the instructional design of the platform facilitate the visually impaired to learn?
3. Is there a need to improve the applied assessment mechanism of this platform?

2. System Architecture and Design

The system development tools include ASP.NET for web page design and web page interconnection, and SQL server for the database management. Platform layout and caveated materials are in accordance with the Web Content Accessibility Guidelines (WCAG) 2.0 design (WCAG2.0, 2008). The platform is designed mainly contains Rule 1.1.1: Provide text alternatives for any non-text content, and Rule 2.2.1: all functionality available from a keyboard, and many more. The platform architecture consists of three modules: learning modules, inquiry module and assessment module shown in Figure 1.

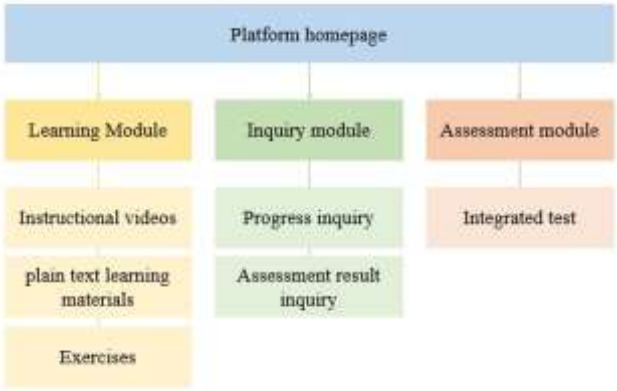


Figure 1. System architecture diagram

The main functions of the system are described as follows:

Visually impaired students can apply for an account to access this online learning system with a screen reader software.

After logging in, the learner can, at his or her will, choose one learning unit, each unit has an instructional videos as well as plain-text based learning materials. A total of 25 learning units are provided in this subject. The plain text learning materials has equal contents of its corresponding video that, when the learner needs to clarify those questions arise during watching the video. The video learning materials consist of not only voice, but also video demonstration of operating process, which provide instant assist from sighted people available for the learner.

This concept of instruction design also refers to that of the Hadley School for the Blind (2016). At the end of each unit, there will be exercise to allow the learner to practice. The learner can view their own learning outcomes in this unit from the recorded data. After taking a series of learning units, learners can use the integrated test function which is similar to a formal typing test. The test questions using narrated audio files playback while the test is given, and typing results entered in the input area on the web. After the end of the integrated test, the system will automatically calculate the correct rate and typing speed, and the result is stored in the database for the instructor to appraise the learners' learning outcomes.

The learning process is shown in Figure 2.

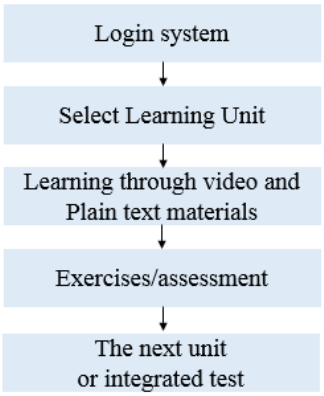


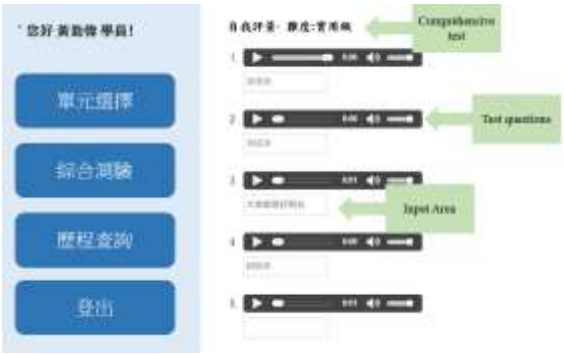
Figure 2. Learning process schematic diagram

3. Interface of the System screen

This section is to show the interface of the main screen and the features of the platform as shown in Table 1.

Table 1: System screens and functions and description

Screen shot	Title	Explanation
	Platform homepage & Learners login page	For convenient browsing, web layout design is very simple. Important title using <h1> and <h2> tags make visually impaired students use the screen reader software shortcut feature to quickly move to the specified blocks. In this page, visually impaired students can click "Start learning" Link, into the learning page.
	Learning pages & units list	In the learning page, learners can choose to open the course list, Integrated test, course record or Sign out. As an example, if the learner chooses "Select Learning Unit", he or she can open a list of all units.
	Video teaching material & Plain text learning materials	Learners learning mainly using video, there are plain text learning materials download link at the bottom of the video, when the learner is completed the learning materials, they can click the "Exercise" to perform the typing practice

	Integrated test	After viewing a series of learning materials, learners can use the Integrated test function which is to simulate the formal typing test. The test questions use narrated audio files playing back one short sentence each time, then the learner enter the text accordingly into the input area on the web. At the end of the integrated test, the system will automatically calculate the correct rate and typing speed.

4. Research Method

Because the platform is still in the prototype stage, formative evaluation was conducted to the target learnings. Moreover, we also consulted experts for collecting their feedback to improve the course ware design as well as system construction, therefore, in practice to visually impaired students to use before, we must first evaluate by professionals, Modify the system architecture based on their opinions.

For this purpose we used semi-structured interview, we interviewed the visually impaired expert with years of teaching experience. He is familiar with the development of web accessibility standards. Before the interview, we sent our first interview outline to respondents, so that respondents can be prepared. The interview process was recorded. The interview focused on the learning layout, materials and assessment functions of this platform for visually impaired students to know whether it is useful and convenient to use.

5. Result

Regarding the navigation of the layout design of the system, respondents said:

On a web page, each title, link or button name should be more clearly defined. Recommends filling the link below a brief description, so that the visually impaired know when clicking link, which page should be directed.

Regarding the ease of learning for the learning materials provided, respondents said:

Video materials design is worthy of recognition, but it is recommended plain text learning materials can be changed online viewing, eliminating the download action.

Finally, about the designed self-assessment mechanism, respondents said:

If each question must press the play button and then learner start typing which makes the test rather cumbersome. The design of Audio files should be improved to modify to the Auto Play.

6. Conclusion

In Taiwan, for visually impaired persons designed e-learning platform is very rare, while the government formulated specification is not updated, which bring high challenge to this research. This study attempted to develop an e-learning platform for visually impaired students with learning Chinese computer input method as a pilot example. According to the results of this study, we will further modify the layout and learning materials of the platform. We hope that this Accessible e-learning platform can eventually help visually impaired students learn the correct Chinese input skills to improve their typing accurate rates, while enjoying the benefits of e-learning.

Acknowledgement

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