Intelligent Reading of Visually Impaired Readers Empowered By Intelligent Technology

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Keywords: Visually impaired readers; Intelligent technology; Intelligent reading; Library; Information need

Abstract: Studies report that 80% information of individual learning derives from vision, the main channel for individuals to perceive information. In particular, in the era of information explosion, the enormous information brings great difficulties in information acquisition for visually impaired readers. The paper investigates the reading of visually impaired readers, and introduces intelligent reading technology. After analyzing the characteristics of the visually impaired readers and clarifying the concept of intelligent reading, it tries to exploit the technical advantages of intelligent reading device, then propose suggestions to implement intelligent reading among visually impaired readers from four angles, government departments, production and R&D departments, libraries, visually impaired readers, to discuss the prospects of intelligent reading for visually impaired readers.

1. Domestic theory of intelligent reading for visually impaired readers

The term visually impaired means the patient suffers certain visual function damage in congenital or acquired accidents, resulting in impaired visual acuity, clarity, etc., which makes the patient unable to gain the same vision as ordinary people and affects his ability to live. The traditional reading of visually impaired readers mainly relies on traditional approaches such as paper Braille books or relatives and friends' reading. The visually impaired patients here involve two cases, blindness and low vision. China implements the standard set by the World Health Organization and divides it into five levels [1].

Table 1 Chinese Grading Standard for Visual Disability

Grade 1	Low vision, with corrected visual acuity at 0.1-0.3
Grade 2	Low vision, with corrected visual acuity at 0.05 (3-meter index) - 0.1
Grade 3	Blindness, with corrected visual acuity at 0.02 (1 meter index) - 0.05
Grade 4	Blindness, with corrected visual acuity at light perception-0.02
Grade 5	Blindness, without light perception

Note: Under good central viewing angle and narrowed viewing angle, if the viewing angle radius is within 10 degrees and the radius from the gaze point exceeds 5 degrees, it is grade 3, and if the radius is less than 5 degrees, it is grade 4.

Thanks to the continuous technological progress, visually impaired readers can not only use reading aids to convert text into sound, but also use screen-reading software to recognize pictures and convert them into sound information. However, the current technological insufficiency makes it still impossible to recognize some abstract and messy pictures. There are both similarities and differences between reading behavior of visually impaired readers and ordinary readers. Compared with traditional reading, intelligent reading pays more attention to readers' reading needs and their satisfaction, which emphasizes the use of intelligent technology for independent, accurate and adaptive reading [2]. By using various science and technology, intelligent reading allows more convenient and humanized way of reading for visually impaired readers, providing users with another new reading mode featuring more realistic and immersive reading experience.

2. Investigation and analysis of intelligent reading among visually impaired readers

2.1 Design of questionnaire on intelligent reading among visually impaired readers

The author designed this questionnaire from the basic information of visually impaired readers, reading behavior, reading aids, and library services for visually impaired readers. There are 21 questions in the questionnaire, the first five questions are about basic information; questions 6 and 7 are about readers' reading behavior; questions 8 to 12 are surveys on the use of reading aids; questions 13 to 20 are designed as library service survey among visually impaired readers; the final question 21 is an open-ended question to understand how visually impaired readers look at the future of visually impaired reading.

2.2 Questionnaire data analysis

This questionnaire had a total of 203 respondents, including 75 males (36.95%) and 128 females (63.05%). Except 2 respondents aged under 18 (inclusive), the rest are adults over 18 years old. Young adults aged 19-30 accounted for 50% of the total sample, and those aged 30-50 accounted for about 25%. It is worth noting that respondents aged over 50 accounted for 20%, as shown in Figure 1. Most respondents in the questionnaire had second-degree blindness or low vision. In the occupational survey of visually impaired readers, except those who are unemployed or retired, respondents are basically service industry personnel, students or personnel in agriculture, forestry, animal husbandry and fishery.

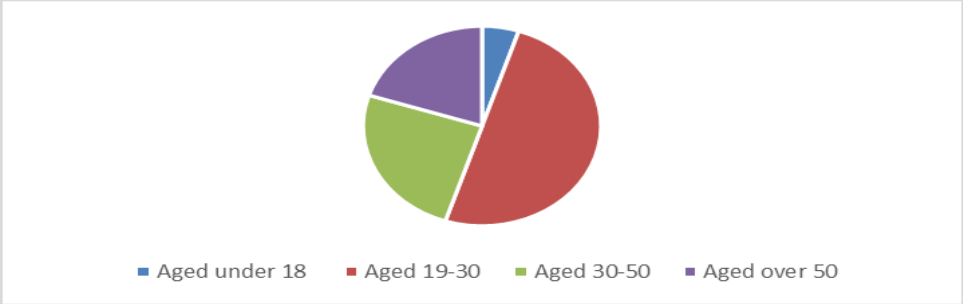

Figure 1 Age structure of visually impaired readers

In the survey about the acceptable price of reading aids, 119 respondents chose less than 1,000 yuan, 69 chose 1,000-3,000 yuan, 13 chose 3,000-6,000 yuan, and only 2 chose 6000-9000 yuan. Table 2 suggests that when visually impaired readers choose reading aids, 62% users choose mobile phones with screen-reading software, and 37% choose computers and visual aids with screen-reading software, indicating that they value more about reading experience than device price.

Table 2 Commonly used reading aids

Choice	Subtotal	Percentage
Computers with screen-reading software	76	37.44%
Mobile phones with screen-reading software	127	62.56%
Vision aids	76	37.44%
Audiobook	68	33.5%
Writing instruments for Braille	90	44.33%
Others	10	4.93%
Effective number of respondents filling in this question	203	

In Table 3, in the survey on the shortcomings of the reading aids currently used by visually impaired readers, more than 50% respondents said high price or operation difficulties, and some readers said excessive volume, screen jitter, etc. Although the survey found that visually impaired readers have certain difficulties in accepting digital reading, it also reflects their urgent need for reading from the side [3].

Table 3 Shortcomings of reading aids currently used by visually impaired readers

Choice	Subtotal	Percentage
Excessive volume	77	37.93%
High price	110	54.19%
Operation difficulty	107	52.71%
Screen jitter	72	35.47%
Narrow field of view	52	25.62%
Single function	75	36.95%
Others	4	1.97%
Effective number of respondents filling in this question	203	

The survey results in Table 4 show that the existing reading aids or the library's visually impaired reading service can help patients access basically the same information as the general public in daily life and learning. Visually impaired readers can access information just like ordinary people through vision aids and screen-reading software. It's just that we see, but they mostly hear.

Table 4 What information needs are met with the aid of reading aids

Choice	Subtotal	Percentage
Job information need	96	47.29%
Leisure and entertainment information need	132	65.02%
Knowledge need	97	47.78%
Dating information need	83	40.89%
Others	1	0.49%
Effective number of respondents filling in this question	203	

In the survey on the library services for visually impaired readers, Table 5 shows that more than 30% choose activities such as reading sharing sessions, oral films, computer training, Braille books or audio-visual resources, provision of barrier-free reading device, advanced reservation and pick-up service, which suggests increasingly abundant library services for visually impaired readers. In the survey "How do you rate the library service for visually impaired readers", 68 people said the service was just so so, 77 said the service was good, 16 said it was very good, and 42 people said the service was poor or very poor. The library service for the visually impaired is at the middle level, with a lot of room for improvement.

Table 5 Library services for visually impaired readers

Choice	Subtotal	Percentage
Activities such as book sharing sessions, oral films, etc.	94	46.31%
Computer training	98	48.28%
Braille books, audio-visual resources	109	53.69%
Provision of barrier-free reading device	82	40.39%
Advanced reservation, pick-up service	75	36.95%
Others	7	3.45%
Effective number of respondents filling in this question	203	

In the survey on the shortcomings of library services for visually impaired readers, according to the survey results in Table 6, 57% and 63% respondents selected unskilled librarians or slow resource update, respectively. It shows that in addition to individual factors such as no accompanist and long distance, library service level also greatly affects visually impaired readers' final access to information.

Table 6 Shortcomings of library services for visually impaired readers

Choice	Subtotal	Percentage
Poor library publicity	90	44.33%
Librarians lack skills and knowledge structure	116	57.14%
Few resources, slow update	128	63.05%
Unreasonable library building layout	76	37.44%
Low service efficiency	96	47.29%
Others	3	1.48%
Effective number of respondents filling in this question	203	

2.3 Analysis on Intelligent Reading Demands of Visually Impaired Readers

(1) Job information need. By using the screen reading software and voice input functions of mobile phones, visually impaired readers can find the job information they need. According to the "Legal Daily.com", "Some enterprises notice the intelligent application market for the blind and actively recruit them. Beijing Mind Interactive Technology Co., Ltd. is one example [4]. (2) Leisure and entertainment information. Using reading aids or software, visually impaired readers can access information from the Internet or library collection resources for pleasure and fun. (3) Dating information need. Visually impaired readers can communicate in the library's visually impaired reading room using dating software like Tencent QQ, WeChat, Momo to share reading experience. According to Tencent QQ's "Online Social Report for Visually Impaired Persons", "74% blind people surf the Internet for social activities to access daily life information, maintain and broaden social relationships and entertainment. (4) Knowledge information need. In the Internet era, visually impaired readers can use mobile phones, computers and other electronic devices to access massive knowledge and information resources on the Internet or in libraries [5].

3. Countermeasures to solve the intelligent reading needs of visually impaired

We hope you find the information in this template useful in the preparation of your submission.

3.1 Set laws to protect the intelligent reading rights of visually impaired readers

China has always concerned how to let people with dyslexia easily access and utilize copyright-protected works of art and safeguard their related cultural rights and interests. As one of the earliest signatories of the “Marrakesh Treaty”, China officially joined the “Marrakesh Treaty” in October 2021, which profoundly affects the domestic development of copyright law [6]. The subject with restricted copyrights and the scope of their responsibilities and services should be clarified, more products in accessible formats should be published and released to protect the main channel for people with dyslexia to access works of art. The "authorized entity" in the Marrakesh Treaty should be introduced, and the "Copyright Law Implementation Regulations" should clearly stipulate that, "Only organizations authorized by the government can invoke relevant fair use terms to produce, distribute or disseminate works in accessible formats through information networks in specific markets." It is necessary to improve the “Law of the People's Republic of China on Public Libraries” and the “Law of the People's Republic of China on the Protection of the Disabled”, and establish a corresponding legal supporting system to facilitate the construction of information barrier-free infrastructure, and orderly safeguard people with dyslexia in China [7].

3.2 Improve intelligent reading device technology with user orientation

The device operating system should be simple, and appropriate auxiliary device should be provided according to the needs of visually impaired readers. It is necessary to collect opinions from users during use, update device functions in a timely manner, keep up with the needs of visually impaired readers, add new functions, and provide device protection for their reading. For example, visually impaired readers report technical problems such as excessive device volume, high price, and operation difficulties during use. Some domestic scholars and device R&D personnel also share opinions on reading aids for the visually impaired readers [8]. For example, Wan Xinyuan et al. once proposed to apply virtual reality technology, human-computer interaction technology and 3D modeling technology to blind readers. Also, Lv Mengchao et al. introduced intelligent blind reader based on STM32. Although these ideas have not been implemented yet, they will materialize with the efforts of device R&D personnel.

3.3 Build a barrier-free intelligent library

Libraries should do a good job in publicity. By using the broadcast media or websites familiar to the visually impaired readers, libraries can push the relevant activities of the library to the readers, so that the local visually impaired readers can know the specific time, content of the services for the visually impaired readers, thus opening up the communication channel between the library and the

visually impaired readers. Libraries should do a good job in the accessibility of reading device and facilities in the library, build blind lanes, sensor doors, toilets for visually impaired readers, etc. in the library to break through the barriers between readers and barrier-free reading. Libraries should adhere to the concept of resource accessibility, consider from visually impaired readers when providing services for them. By inviting visually impaired readers to the library, conducting door-to-door inquiries, etc., libraries can collect suggestions from readers, improve relevant library resources, and better serve visually impaired readers [9].

3.4 Improve the awareness and ability of visually impaired readers to participate in intelligent reading

Better services for visually impaired readers need not only the efforts of the government, society, production departments, and libraries, but also the subjective initiative of the readers themselves. Visually impaired readers should sharpen awareness in accessing independent information, avoid passively accessing information due to physical reasons. Only limited information can be accessed with the help of others. Visually impaired readers should actively participate in reading clubs and oral film activities organized by the community or library, positively participate in the reading aids training activities provided by the library to better access information and read independently. In the process of reading, readers can gain knowledge and improve themselves.

4. Conclusions

Due to their biological factors, visually impaired readers are unable to access information through or purely through vision. In this society where information is frequently updated, too fragmented, and mixed with useless information, visually impaired readers face much greater difficulty in accessing the required information [10]. Although visually impaired readers have certain commonalities with the public in terms of information needs, their personalized information needs are also particularly prominent. Therefore, it is quite important to provide intelligent reading for visually impaired readers through various intelligent technologies. The optimization of reading services for visually impaired readers cannot be achieved overnight, but requires efforts from multiple parties. Reading device also has technical problems such as transmission screen jitter and low information recognition accuracy. Social problems such as barrier-free environment construction and colored spectacles need to be solved urgently. However, it is believed that with the efforts of all walks of life, in the future, visually impaired readers can truly experience intelligent reading through intelligent reading aids.

Acknowledgements

This paper is one of the phased results of the 2022 scientific research project of Jilin Provincial Department of Education "Research on Integrated Education and Learning Support for Visually Impaired College Students", project number: JJKH20220617SK.

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