

Relationship between vision and reading performance among low vision students

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Abstract. To determine the reading performance of low vision students after providing optimum reading material and to determine the relationship between vision and reading performance. 53 students (Form 1 to Form 5) who can read print from a Secondary Special Education School (Blind) took part in this study. Distance and near visual acuity were measured. Reading performance was determined using a comprehension test and reading speed. The students were divided into two groups based on their reading speed; Group A was those who could read at a normal reading speed \pm 1S.D. while Group B was those who read at a slower reading speed (normal reading speed below 2S.D.). The normal reading speed was determined from 150 students from the main secondary stream. Comprehension test results showed that there was a significant difference ($p=0.047$) between the two groups. Group A showed a higher comprehension test result than Group B. However, there was no significant difference in the distance and near visual acuity between the two groups. There were also no significant relationship on visual status (distance and near visual acuity) and reading performance (reading speed and comprehension) in the two groups. Low vision students who have a normal reading speed have better comprehension ability compared to low vision students with slower reading speed. Slower reading speed may reduce comprehension ability but it is not necessarily due to the visual status. © 2005 Elsevier B.V. All rights reserved.

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1. Introduction

Reading is the ability to gather visual information from the pages and the ability to understand the text [1]. Reading is a complex task, which involves visual factors and non-

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visual factors such as motor coordination, motivation and cognitive ability. During reading, normally word recognition is done automatically by the reader. However, when the reading speed is slower due to vision impairment the reader will have to make an extra effort for word recognition. This may affect comprehension [2]. A previous study by Sloan and Habel [3] found that there was no significant difference in the reading speed of students that used bigger print materials compared to students using low vision aids. Other studies reported that reading speed for low vision patients was slower compared to normal persons even though they were given bigger or optimum print size [4,5]. Previous studies have been conducted to see if a slower reading speed will affect the comprehension ability of low vision patients but inconclusive findings were reported [6,7]. Dickinson and Rabbit [8] found that visual impairment caused reading difficulty in low vision patients hence affecting the ability of those persons to recall the texts. However Legge et al. [9] found that the ability of comprehension was not affected even though the reading speed was slower. Watson et al. [10] found that training the low vision persons to use the clues in the texts during reading provide a positive effect on their comprehension ability. Smith [11] also found that faster reading speed with low vision devices could be achieved with regular training. Due to the inconclusive findings in other studies, this study was therefore conducted (1) to determine the reading performance (reading speed and comprehension ability) of low vision students after providing optimum reading materials and (2) to determine if there is any relationship between vision and reading performance among low vision students.

2. Methods

53 students (Form 1 to Form 5) who can read print from a Secondary Special Education School (Blind) took part in this study. Only 11 students used low vision devices (LVDs) when reading. 42 students read either using enlarged print and/or by changing the reading distance. Prior to the reading performance test, distance visual acuity was measured using the Bailey-Lovie LogMAR Chart and the results were recorded. Near visual acuity was measured using a Malay alphabet near reading chart and the results were recorded using the point system.

Reading performance was determined using reading speed and a comprehension test. The reading speed test used Malay language near reading unrelated words chart so that the students did not get any clues from the text. The low vision students were asked to read the text loudly. The size of the text used to measure the reading speed was one size bigger than the near visual acuity measured earlier. This is to make sure that vision is not a factor that causes slower reading speed among the low vision students. Reading speed refers to the total number words read correctly in 1 min and was reported as word per minute (wpm).

Comprehension test was tested using selected Malay language articles, which were chosen by the class teachers from each form. The size of the article used to measure the comprehension test was one size bigger than the near visual acuity measured earlier. The low vision students were asked to read the article quietly. Next the students were asked to answer 10 objective questions without referring back to the article. No restriction of time was imposed on the low vision students. The correct answers were reported in terms of percentage.

Table 1
Mean reading speed, comprehension, level of distance visual acuity and level of near visual acuity for Group A and Group B

Parameters	Group A (n=16)	Group B (n=37)
Reading speed (wpm)	97.69 ± 22.47	33.97 ± 16.79
Comprehension (%)	83.75 ± 11.47	74.86 ± 19.94
Distance VA (log)	1.13 ± 0.31	1.14 ± 0.46
Near VA (N point)	10.25 ± 7.62	10.92 ± 4.84

The low vision students were divided into two groups based on their reading speed; Group A was those who could read at a normal reading speed ± 1 S.D. while Group B was those who read at a slower reading speed (normal reading speed below 2S.D.). For the control group, normal reading speed was determined using 150 students from the main secondary stream. The control students were randomly selected from Form 1 to Form 5. The inclusion criteria were visual acuity of better than 6/7.5, near visual acuity of better than N10 with good binocular vision and with no ocular diseases. Similarly, the size of the article used to measure the reading speed was one size bigger than the near visual acuity measured earlier.

3. Results

The normal reading speed determined from 150 normal students was 102.83 ± 32.72 wpm. The range of normal reading speed was between 70.11 and 135.55 wpm. This finding was used as a baseline to divide the low vision students into two groups. Group A was those who could read at a normal reading speed (± 1 S.D.) while Group B was those who read at a slower reading speed (normal reading speed below 2S.D.). Based on this, it was found that 16 low vision students read within normal reading speed (Group A) and 37 low vision students read with slower reading speed (Group B). The mean reading speed for Group A was 97.69 ± 22.47 wpm while the mean reading speed for Group B was 33.97 ± 16.79 . Mean for the comprehension test for Group A was $83.75 \pm 11.47\%$ while Group B was $74.86 \pm 19.95\%$. Student's *t*-test showed that there was a significant difference $p < 0.047$ in the comprehension between the two groups. The mean of distance and near visual acuity for Group A was 1.13 ± 0.31 log MAR and $N10.25 \pm 7.62$ respectively. The mean of distance visual and near acuity for Group B was 1.14 ± 0.46 log MAR and $N10.92 \pm 4.84$ respectively. Table 1 showed the summary of the results. Student's *t*-test also showed that there were

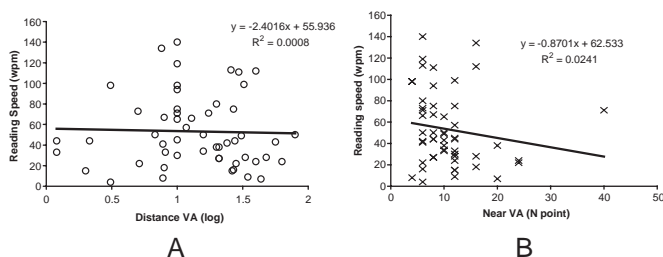


Fig. 1. Reading speed of the low vision students did not show any significant relationship with distance visual acuity or near visual acuity.

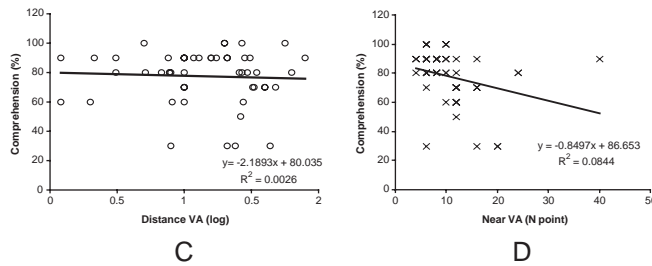


Fig. 2. Comprehension also did not show any significant relationship with either distance visual acuity or near visual acuity.

no significant differences in the mean for distance VA ($p=0.90$) and near VA ($p=0.78$) for both groups.

Regression analyses were conducted to determine if there is any relationship between vision (distance and near) reading speeds and illustrated in Fig. 1. Graph A showed the relationship between reading speed and distance vision while Graph B showed the relationship between reading speed and near vision for low vision patients. It was found that there was no significant relationship between reading speed and vision either distance ($R^2=0.0008$) or near ($R^2=0.0241$). However, it was seen that there is a slight reduction in the reading speed when the vision (distance or near) is worse. Similar findings were noted when regression analyses (Fig. 2) were conducted between vision (distance and near) and comprehension. However there is a slight trend of reduction of percentage in comprehension when near vision is reduced (Graph D, $R^2=0.0844$) compared to when distance vision is reduced (Graph C, $R^2=0.0026$).

4. Discussion

This study found that most of the low vision students (63%) read at a slower reading rate compared to normal students, which was 1S.D. from the mean reading speed of normal students. These finding supports previous studies, which suggested that reading speed of low vision subjects, was slower when compared to normal subjects even though an optimal reading text was provided [4,5]. When the comprehension ability of Groups A and B were compared, it was found that Group A was significantly higher ($p=0.047$) compared to Group B. This finding also supported by Dickinson and Rabbitt [8] which suggested that visual impairment can reduce the ability to recall the text that have been read by low vision subjects. This finding suggests that reading performance will be affected when visual acuity was reduced. Group B showed slower reading speed compared to Group A suggesting that the low vision student in this group may have difficulties in recognising the words and require extra effort to process the visual information. Hence less effort was made to understand the text. However, the ability to understand text did not depend solely on vision but there were other factors such as IQ level which was not considered in this study. Reading speed depends on the ability of an individual to recognise words [12], while comprehension depends on the ability to integrate the information gathered from the text [13]. It is expected that when vision was reduced, the reading speed will be worse. However, our findings showed that there was no significant

difference for the mean vision (distance or near) between the two groups. These findings suggest that slower reading speed and reduced comprehension ability in Group B is not necessarily due to reduced vision. This study also found that there were no significant relationship between vision (distance or near) and reading performances (reading speed or comprehension). Previous studies support these findings [4,14] suggesting that other factors such as scotoma, media ocular clarity and age may effect reading speed of the low vision patients.

5. Conclusions

Low vision students who have normal reading speed in this study have better comprehension ability compared to low vision students with slower reading speed. Slower reading speed may reduce comprehension ability but it is not necessarily due to the visual status.

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