Evaluation of a Newly Developed Online Color Training System

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This study evaluated a newly developed online color training system. The system incorporated basic color training, shade guide matching, and clinical shade selection simulation exercises. Thirty-seven dental students went through baseline Vita-Vita testing with VITA Classical shade guides and then practiced color training exercises with the system for 4 days; the same test was performed after the training program. The average correct match increased from 6.7 (41.88%) to 11.38 (71.13%) using the shade guides ($P < .001$) and from 9.67 (60.42%) to 13.06 (81.63%) using the color training system ($P < .001$). The effectiveness of the color training system in improving color-matching quality was confirmed. *Int J Prosthodont 2011;24:137–139.*

Visual shade selection has been demonstrated to be inaccurate and lack consistency both within and between individuals.[1,2] Previously, color samples and shade guides have been used as effective color training tools.[3] However, limitations with this method are obvious (eg, many shade guides are needed and it is difficult to record the training data). Color training software also has been introduced, but it can only record the individual's training data and the monochromatic rectangles in the software are quite different from actual shade tabs.[3] In this study, an online color training system was developed, and its effectiveness was evaluated.

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Materials and Methods

The color training system consisted of a training interface and administer system for user management and data collection. Basic color training, shade guide matching, and clinical shade selection simulations were incorporated into the system. The basic color training included value and chroma training, and both contained matching and ranking exercises (Fig 1). VITA Classical, VITA 3D-Master, Chromascop (Ivoclar Vivadent), and Shofu NCC Standard shade guide systems were all incorporated into the shade guide matching exercises. Matching exercises were subdivided into three levels (Fig 2). In clinical shade selection simulation exercises, users were required to match the clinical tooth image with VITA Classical shade guide tabs (Fig 3). The system was developed using Java language on an Eclipse Platform (Eclipse Foundation).

Thirty-seven color-normal dental students (18 males, 19 females; mean age: 23 years) from the Peking University School of Stomatology volunteered to participate in this study. All participants underwent Vita-Vita testing under natural light conditions between 10:00 am and 2:00 pm on a black background (shade guide system hands-on matching).[3] One month later, a 30-minute lecture entitled "Introduction to the Online Color Training System" was organized for participants, and they were again tested, this time using the color training system. The test was based on the VITA Classical shade guide system (level 3) with a black background (Fig 2). During the next 4 days, volunteers went through basic color matching and VITA Classical matching exercises (including levels 1 to 3).

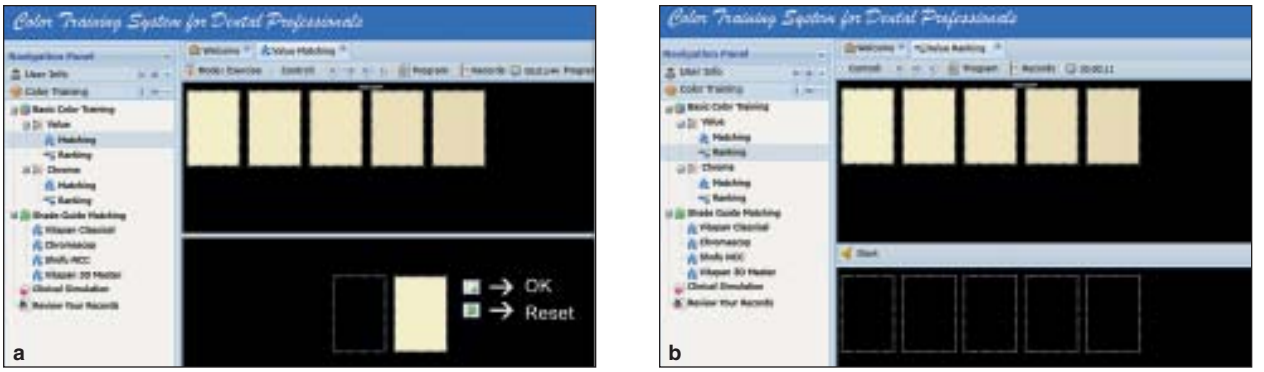

Fig 1 Basic color training. **(a)** Matching exercises required users to match the target color sample, while **(b)** ranking exercises required users to rearrange the color samples according to the original order (the original order was altered when the user clicked "Start").

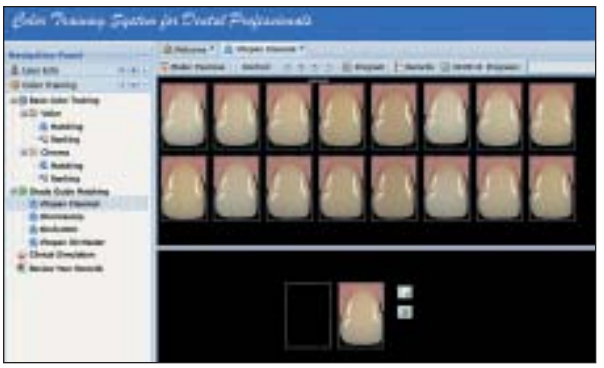

Fig 2 VITA Classical shade guide matching: level 3.

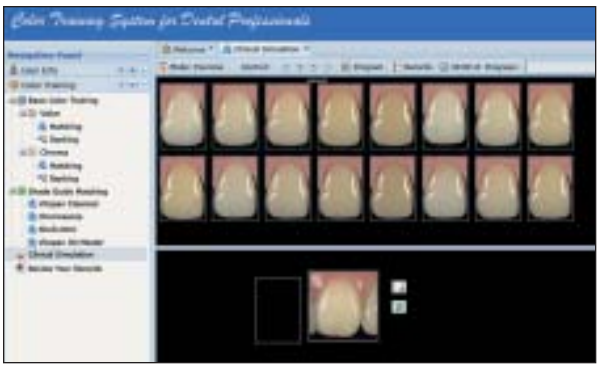

Fig 3 Clinical shade selection simulation.

Each exercise was performed once each day. The students did not get to touch the shade guides after the baseline examination or during the training program. When the program was finished, students were tested again with the system and later with the shade guides within 1 week.

Test results were compared using a paired-sample *t* test and SPSS 16 (IBM) statistical software. Correlations among the results observed with the shade guides and training system were determined using linear regression analysis. The level of significance was set at $\alpha < .05$.

Results

The test results are listed in Table 1. The two tests showed significant correlations in number of correct matches and test time (Fig 4). Pearson correlation coefficients *(r)* were as follows: $r = 0.426$ for number of correct matches and $r = 0.230$ for test time.

The training data are summarized in Table 2. The average training time was 22.80 ± 10.21 minutes per day. Significant differences in time and the percentage of correct matches were observed between all levels of training groups ($P < .01$); however, time spent was not significant between value groups ($P = .365$).

Discussion

The test results and the regression analysis indicated the effectiveness of the training system on improving the shade-matching quality of participants. Similar improvements were reported by Paravina[3] when the software was applied in color training.

To ensure that the system was effective, three different color-matching exercises were incorporated into the system. Users have to distinguish the difference in color and match the target sample, which simulates the clinical shade selection progress and thus improves color-matching ability.

Compared to software, the online training method is more efficient since all training data are submitted to the server automatically and can be exported for further analysis (Table 2). The manager of the system can obtain the overall training information or an individual's training record. Also, since more and more people are using the Internet, the online training system is easily available.

A survey entitled "Teaching of Color Concepts and Skills" revealed the weaknesses in color teaching and asked for improvement in color science education.[4] The newly developed online color training system may offer such help, especially for dental schools.

Table 1 Results of the Vita-Vita Test Before and After the Training Program

	Shade guides			Online training system		
	Correct matches (n)	Percent correct (%)	Time (min)	Correct matches (n)	Percent correct (%)	Time (min)
Before	6.70 ± 3.04	41.89 ± 19.03	11.27 ± 7.84	9.76 ± 2.83	60.98 ± 17.70	11.85 ± 6.22
After	11.68 ± 2.87*	72.97 ± 17.92*	11.89 ± 4.67	13.05 ± 1.91*	81.59 ± 11.96*	8.66 ± 4.58*

*Significant difference.

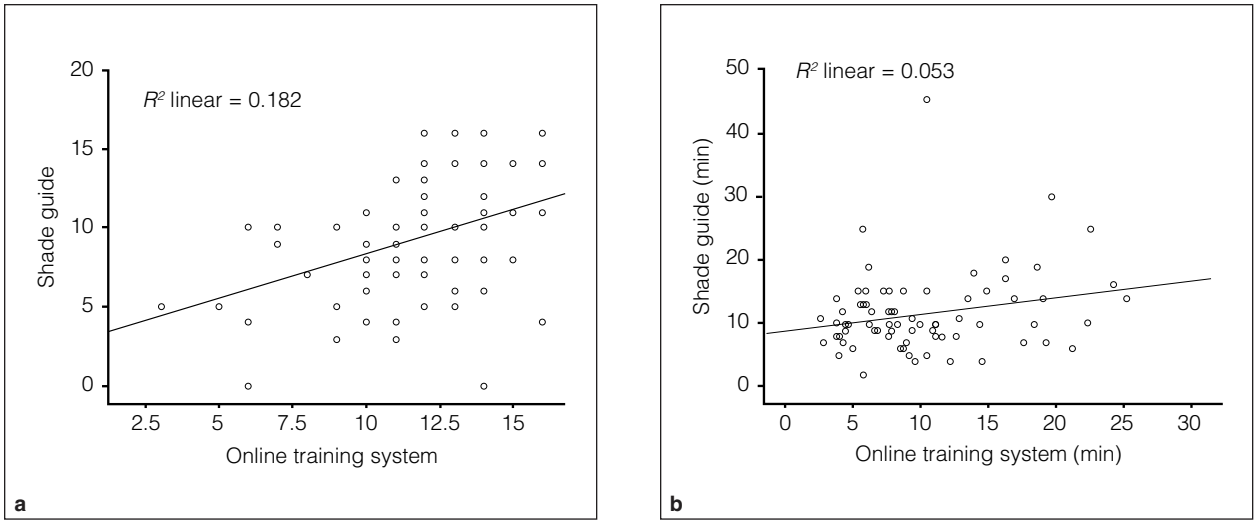

Fig 4 Correlation for **(a)** number of correct matches and **(b)** test time.

The evaluation of the system was preliminary, and improvement was confirmed by comparing the before and after training test results. Further studies should include a control group and compare the results with those of other color training systems.

Conclusion

Color-matching quality of the dental students was improved by the color training system. This online system provides an effective and efficient tool for education in color science.

Table 2 Mean Time Spent and Percentage of Correct Matches for Training Group Levels

	Time (min)	Percent correct (%)
Value level 1	1.64 ± 1.21	64.25 ± 14.58
Value level 2	1.81 ± 1.08	54.06 ± 17.14
Chroma level 1	1.89 ± 1.15	54.83 ± 17.53
Chroma level 2	1.36 ± 1.06	63.27 ± 20.90
VITA Classical level 1	1.94 ± 0.92	85.89 ± 10.63
VITA Classical level 2	4.90 ± 2.47	70.70 ± 14.61
VITA Classical level 3	9.25 ± 4.35	61.48 ± 18.00

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