

AR Toothbrushing Machine on Plaque Control, Self-efficacy and Skill of Toothbrushing in School Children



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Background

Augmented reality (AR) is an interactive experience of real world and virtual environment, which has been used as a learning tool for children in different fields. In this study, a mobile AR toothbrush machine was used to allow school children to operate an optical toothbrush on a dental model to remove simulated dental plaque, and learn the correct method of brushing teeth with a 3-minute brushing song.

Objective

We aimed to evaluate the effect of AR brushing machine on the dental plaque control and brushing skills in elementary school children in Taiwan.

Method

Study design: Quasi-experimental design

Participant: Grade 3-6 students were recruited and assigned to the AR group (EG; n = 290) and the control group (CG; n = 311).

Outcome variable: Bass method and Self-Efficacy and Plaque control record.

Intervention: All students underwent a 4-week intervention: students in the AR group received instructional interventions using an AR brushing machine; students in the traditional group received a classroom-based Bass method of toothbrushing by a dental hygiene professional.

Data collection: Bass brushing method and Self-Efficacy and Plaque control record (PCR) were performed at the baseline, 2 weeks and 4 weeks after the intervention.

Statistical analysis: The generalized estimating equations was used to evaluate the outcomes between two groups over time.

Results

The EG exhibited greater improvement in PCR [$\beta = -5.17$, effect size (ES) = 0.24] at the 2-week follow-ups than the CG did. The self-efficacy of toothbrushing in the EG exhibited greater improvement ($\beta = 0.38$ and 0.53 , ES = 0.16 and 0.22) at the 2-week and 4-week follow-up than the CG did. However, the students in the EG had less improvement in Bass toothbrushing technique (odds ratio = 0.44 and 0.49) at 2- and 4-week follow-up than the CG did.

Conclusion

The mobile AR can improve dental plaque control and self-efficacy of toothbrushing in elementary schoolchildren.

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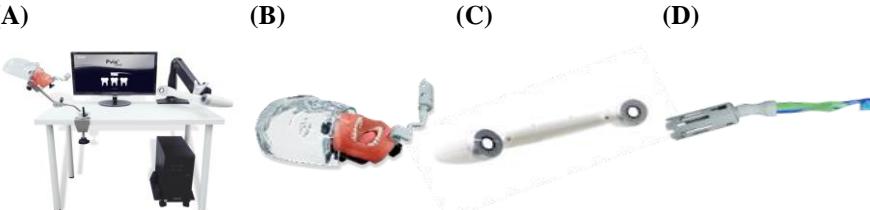


Fig1. (A) AR Brushing Machine (B) A 3D training head model (C) An optical tracking unit (D) A wireless toothbrush

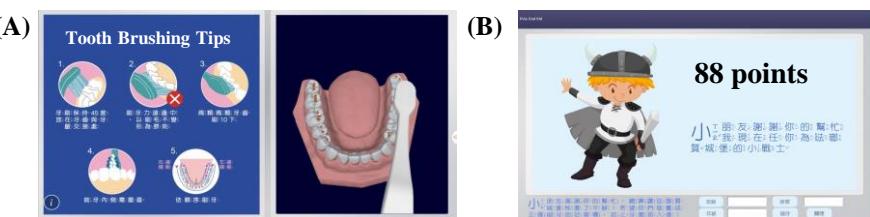


Fig2. (A)Learn Bass Brushing Method (B)Test score



Fig3. Intervention (EG)
(A) Pretest (B) A short instructional story
(C) Learn brushing techniques using a toothbrush machine (D) 2-week and 4-week post-test



Fig4. Intervention (CG)
(A) Pretest (B) A short description of the Bass method of tooth brushing
(C) Demonstrate toothbrushing skills (D) 2-week and 4-week post-test



Table 1. Bassline information of students at AR and traditional group

	AR group (n=290)		Traditional group (n=311)		p
	N	%	N	%	
Gender (N, %)					0.173
Male	156	53.8	150	48.2	
Female	134	46.2	161	51.8	
Grade					0.307
3 rd grade	75	25.9	96	30.9	
4 th grade	78	26.9	81	26.1	
5 th grade	69	23.8	57	18.3	
6 th grade	68	24.5	77	24.8	
Plaque control record (M±SD)	85.2	±17.5	85.4	±15.7	0.880
Bass brushing method	44	15.2	52	16.7	0.605
Self-efficacy (2-10)(M±SD)	7.4	±2.1	7.5	±19.7	0.420

Chi-Square Test: analyzed gender and grade
independent samples t-test: analyzed Plaque control record

Table 2. Regression-estimated change of tooth brushing skill, self-efficacy, plaque control record between two groups

	OR	β (95%CI)	ES	p
Bass brushing method				
Group (AR group) × Time (2 weeks)	0.44	(0.27, 0.73)	0.001	
Group (AR group) × Time (4 weeks)	0.49	(0.30, 0.80)	0.005	
Self-efficacy				
Group (AR group) × Time (2 weeks) ^a	0.38 (0.74, 0.02)	0.16	0.038	
Group (AR group) × Time (4 weeks) ^a	0.53 (0.88, 0.17)	0.22	0.004	
Plaque control record				
Group (AR group) × Time (2 weeks) ^a	-5.17 (-8.9, -1.4)	0.24	0.007	
Group (AR group) × Time (4 weeks) ^a	1.67 (-2.1, 5.5)	0.07	0.386	

Effect size calculated as and the mean difference of change between baseline and 2- and 4-week follow-up measurement between two groups; 0.20 is small, 0.50 is moderate, and 0.80 is large.

^a Reference group, traditional group × baseline

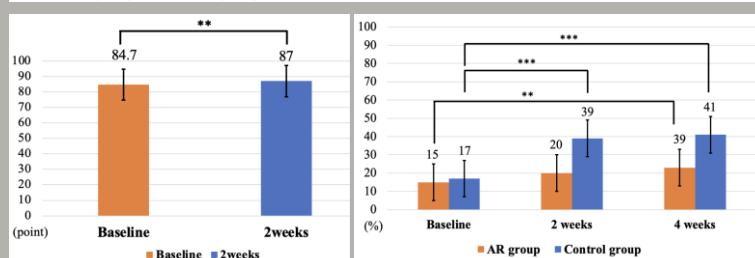


Fig3a. Differences of AR Toothbrushing Machine score at Baseline and 2 weeks (*p < 0.05; **p < 0.01; ***p < 0.001)

Fig3b. Differences of Bass brushing method at baseline, 2 weeks, and 4 weeks by two groups (*p < 0.05, **p < 0.01, ***p < 0.001)

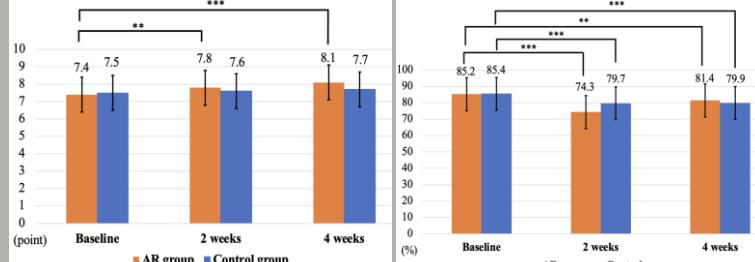


Fig3c. Differences of self-efficacy at baseline, 2 weeks, and 4 weeks by two groups (*p < 0.05, **p < 0.01, ***p < 0.001)

Fig3d. Differences of plaque control record at baseline, 2 weeks, and 4 weeks by two groups (*p < 0.05, **p < 0.01, ***p < 0.001)