

Retrieval practices (multiple choice testing) and recall of multiplication tables – a Year 4 trial and parallel Year 5 replication

INTRODUCTION

There is evidence that exposure to a multiple choice test that children do not know the answer to can improve the learning of that information on a later occasion (Little and Bjork, 2010). Little and Bjork suggest that when children do not know the answer they may attempt to retrieve other relevant information in order to assess why the other answers are not correct and to ultimately deselect the most unlikely answers (Little and Bjork, 2010). Engaging in this form of mental processing leads to a test becoming a learning event in itself.

Our previous research suggested that when used in conjunction with Look, Cover, Write, Check, retrieval practice could help young children when learning new spellings. However, retrieval practice alone was not beneficial.

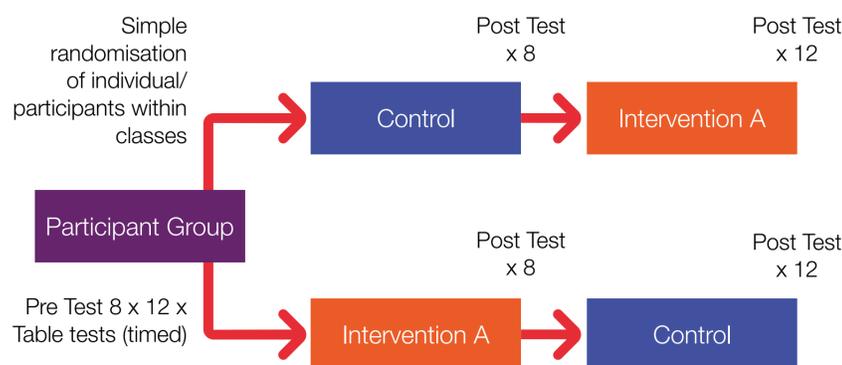
THE RESEARCH DESIGN

A within-participant design with a pre- and post-test was used. The pre-test was conducted prior to randomisation. The independent variable **multiple choice testing** was defined operationally by creating two counterbalanced conditions:

- IV Level I (Control condition) – no multiple choice testing, normal classroom practice
- IV Level II (Intervention A) – multiple choice testing

Figure 1. Research design

Counterbalanced, pre- and post-test within-participant design (two levels to the independent variable)



LIMITATIONS

The initial sample size of 216 children was reduced to 199 due to attrition as a result of pupil absence. All children involved in the study were from two schools serving similar socio-economic backgrounds, which may not be representative of the whole population.

METHOD

Participants

Westfield Community School and Platt Bridge Academy together form the Westbridge Teaching School Alliance. The two primary schools serve two separate communities in Wigan with high levels of socio-economic deprivation. The research was completed in four Year 4 classes (two in each school) and also replicated in four Year 5 classes (two in each school). Classes were already stratified in mixed ability and mixed gender groups. To achieve counterbalancing, each of the classes in each school was randomly allocated to the order in which they experienced the two conditions. A total of 216 children were due to take part in the study; however, 17 pupils were removed due to attrition of one or more test results. The results are based on 199 participants (91 Year 4 pupils and 108 Year 5 pupils).

Procedure

Pupils completed a pre-test of all multiplication facts from their 8 x and 12 x tables two weeks before the trial to reduce possible learning from the initial test.

- The **control condition** consisted of ten multiplication facts being copied out and tested with a partner (normal classroom practice).
- **Intervention A** consisted of ten multiplication facts, using a multiple choice test 'as a learning event'. Pupils were given the correct answer at the end of each multiple choice test.

There was a wash-out period of one week between each condition to reduce carryover effects (see Churches and Dommett, 2016). At the end of each condition, pupils were tested on the multiplication facts they had learnt through a timed test, as used in the pre-test before the trial began.

Materials

The researchers selected multiplication facts from the 8 x and 12 x tables as identified in the National Curriculum Programmes of Study for Maths for KS2 pupils. Timed test sheets were created for pupils' pre- and post-tests. Multiple choice sheets were created for the trial; three versions of the multiple choice testing sheets were created so that the pupils saw the answers to the multiplication facts in a different order in each of the three weekly sessions, to try to reduce the risk of pupils simply recalling which answer order was correct.

CONCLUSIONS AND RECOMMENDATIONS FOR FUTURE RESEARCH

Use of the multiple choice testing method produced equal progress in Year 4 classes compared to the control condition. However, it may have reduced progress in Year 5 classes, suggesting it could have a negative effect on pupils' recall of times tables facts. This may be because the previously identified positive effects of multiple choice alone were in subject areas where children were able to infer associations between new and existing knowledge rather than in the learning of something completely new (as with a previously unseen times table fact). In contrast, times tables might be better learned with strategies that encourage multiple rehearsal and automaticity of recall.

RESULTS

Gain scores were calculated from pre- and post-test scores in the graph below (Figure 2 – Year 4, Figure 3 – Year 5).

Figure 2. Year 4 Pre- and post-test multiplication scores for the control and intervention groups

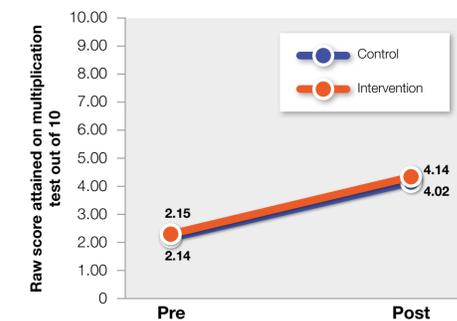
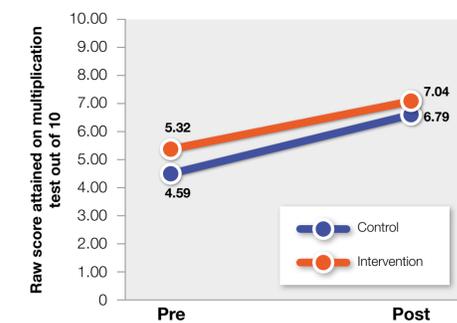


Figure 3. Year 5 Pre- and post-test multiplication scores for the control and intervention groups



One-tailed Wilcoxon signed-rank tests indicated that the effect of both conditions was small and non-significant. Table 1 shows effect sizes, confidence intervals and p-values for each class group.

Table 1. Trial and replication results†

	Year 4 (trial) Groups	Year 5 (replication) Groups
Effect size (r) [d]	-0.03 [0.06]	-0.09 [-0.18]
CI (95%)	-0.18 to 0.23	-0.271 to 0.104
p-value	0.184	0.154

† Test identification and analysis were carried out using StatsWizard®.

This research was carried out with funding and support from:

