Technical Appendix

Definition

Traditional teaching keeps time spent on a topic constant and allows pupils' 'mastery' of curriculum content to vary. Mastery learning keeps learning outcomes constant and but varies the time needed for pupils to become proficient or competent at these objectives. The mastery learning method breaks subject matter into blocks or units with predetermined objectives and specified outcomes. Learners must demonstrate mastery on unit tests, typically 80%, before moving on to new material. Any pupils who do not achieve mastery are provided with extra support through a range of teaching strategies such as more intensive teaching, tutoring, peer-assisted learning, small group discussions, or additional homework. Learners continue the cycle of studying and testing until the mastery criteria are met.

Some of the ideas behind mastery learning date back to American schools in the 1920's with the work of Washburne (1922, as cited in Block, 1971). A version of mastery learning was revived in the form of programmed instruction in the late 1950's based on the work of Skinner. It aimed to provide students with instructional materials that would let them move at their own pace and receive constant feedback on their level of mastery (see also Individualised instruction). During the 1960's Bloom's (1968) 'Learning for Mastery' led to a resurgence of interest from both researchers and practitioners. He is now generally acknowledged as the originator of the mastery model. Bloom argued that learners would not spend more time overall on activities to achieve proficiency. Although it may take longer in the early stages, he suggested learners would need less time to master more advanced material because of their higher levels of basic competence.

In terms of assessment and feedback, a number of aspects of mastery learning are similar to other contemporary approaches such as the use of initial diagnostic assessments like universal screening in Response to Intervention models (Mellard & Johnson, 2008). The use of formative assessments and tests to monitor pupils' progress systematically then give detailed feedback on what they need to do to close the gap between their current performance and the desired goal is similar to assessment for learning and feedback models (Black and Wiliam, 1998; Hattie & Timperley, 2007).

Mastery learning is therefore not a new approach, though different versions have been developed and used at different times. It is based on the belief that all pupils can learn when provided with appropriate activities and support. All pupils must achieve a pre-specified level of mastery on one unit before they can to progress to the next. Learners are also provided with specific feedback about their progress at regular intervals. This helps learners identify where they have been successful and where they have been less successful. Any objectives in the curriculum which have not been learned are given more time and more effort to achieve mastery.

Search terms: Mastery learning, learning for mastery

Evidence Rating

There are five meta-analyses included in the summary, but none of these have been conducted in the last 10 years. The pooled effects from these syntheses range from 0.04 to 0.60 so do not provide a consistent estimate of effect. This variation is not explained by moderator analyses. A number of the meta-analyses include experimental and quasi-experimental studies which are not well controlled. The pooled effects in the early studies are simple means or median values rather than weighted models (fixed effect or random effects). In addition, studies have not been adjusted for clustering. More recent studies have shown mixed effects. Overall the evidence is rated as moderate.

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A meta-analysis of instructional systems applied in science teaching

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Summary of effects

Meta-analyses	Effect size	FSM effect size
Bangert-Drowns, R. L., Kulik, J. A., & Kulik, C.-I. C., (1983)	0.05	-
Guskey, T. R., & Pigott, T. D, (1988)	0.60	-
Kulik, C. L. C., Kulik, J. A., & Bangert-Drowns, R. L., (1990)	0.52	-
Slavin, R. E., (1987)	0.04	-
Waxman, H. C., Wang, M. C., Anderson, K. A., Walberg, H. J., & Waxman, C., (1985)	0.39	0.11
Willett, J. B., Yamashita, J. J., & Anderson, R. D, (1983)	0.59	-
Single Studies	Effect size	FSM effect size
Jerrim, J., Austerberry, H., Crisan, C., Ingold, A., Morgan, C., Pratt, D., Smith, C. & Wiggins, M. (2015)	0.06	0.07
Kalia, A. K. (2005)	1.64	-
Miles, K. (2010)	0.53	-
Vignoles. A., Jerrim, J. & Cowan, C. (2015)	0.10	-
Effect size (weighted mean)	0.40	

The right hand column provides detail on the specific outcome measures or, if in brackets, details of the intervention or control group.

Meta-analyses abstracts

1 *Bangert-Drowns, R. L., Kulik, J. A., & Kulik, C.-I. C. (1983)*

This meta-analytic synthesis of findings from 51 studies indicated that use of an individualized teaching system has only a small effect on student achievement in secondary school courses. This result was consistent across a variety of academic settings and research designs and held true for both published and unpublished studies. In addition, individualized teaching systems did not contribute significantly to student self-esteem, critical thinking ability, or attitudes toward the subject matter being taught. Findings from studies of individualized college teaching are strikingly different from these secondary school findings.

5 *Guskey, T. R., & Pigott, T. D (1988)*

This paper presents a synthesis of findings from 46 studies on group based applications of mastery learning strategies. Meta-analytic procedures were used to combine the results of the studies and to calculate estimates of the effects of group-based applications. Results show that such applications yield consistently positive effects on both cognitive and affective student learning outcomes, as well as several teacher variables. Variation in the size of the effect across studies was found to be quite large, however, and homogeneity tests indicated that studies do not share a common effect size. Several factors were explored as possible explanations for this variation, including the subject area to which mastery learning was applied, the grade level of students involved and the duration of the study. Other possible explanations for this variation are discussed, along with implications for future directions in the research.

10 *Kulik, C. L. C., Kulik, J. A., & Bangert-Drowns, R. L. (1990)*

A meta-analysis of findings from 108 controlled evaluations showed that mastery learning programs have positive effects on the examination performance of students in colleges, high schools, and the upper grades in elementary schools. The effects appear to be stronger on the weaker students in a class, and they also vary as a function of mastery procedures used, experimental designs of studies, and course content. Mastery programs have positive effects on student attitudes toward course content and instruction but may increase student time on instructional tasks. In addition, self-paced mastery programs often reduce the completion rates in college classes.

13 *Slavin, R. E. (1987)*

Several recent reviews and meta-analyses have claimed extraordinarily positive effects of mastery learning on student achievement, and Bloom (1984a, 1984b) has hypothesized that mastery-based treatments will soon be able to produce "2-sigma" (i.e., 2 standard deviation) increases in achievement. This article examines the literature on achievement effects of practical applications of group-based mastery learning in elementary and secondary schools over periods of at least 4 weeks, using a review technique, "best-evidence synthesis," which combines features of metaanalytic and traditional narrative reviews. The review found essentially no evidence to support the effectiveness of group-based mastery learning on standardized achievement measures. On experimenter-made measures, effects were generally positive but moderate in magnitude, with little evidence that effects maintained over time. These results are discussed in light of the coverage versus mastery dilemma posed by group-based mastery learning.

16 *Waxman, H. C., Wang, M. C., Anderson, K. A., Walberg, H. J., & Waxman, C. (1985)*

To estimate the effects of adaptive education on cognitive, affective, and behavioral outcomes of learning, 309 effect sizes were calculated using statistical data from 38 studies that contained a combined sample of approximately 7,200 students. The substantial mean of the study weighted effect sizes is .45, suggesting that the average student in adaptive programs scores at the 67th percentile of control group distributions. The effect appeared constant across grades, socioeconomic levels, races, private and public schools, and community types. In addition, the effects were not significantly different across the categories of adaptiveness, student outcomes, social contexts and methodological rigor of the studies.

18 *Willett, J. B., Yamashita, J. J., & Anderson, R. D (1983)*

This article is a report of a meta-analysis on the question: “What are the effects of different instructional systems used in science teaching?” The studies utilized in this meta-analysis were identified by a process that included a systematic screening of all dissertations completed in the field of science education since 1950, an ERIC search of the literature, a systematic screening of selected research journals, and the standard procedure of identifying potentially relevant studies through examination of the bibliographies of the studies reviewed. In all, the 130 studies coded gave rise to 341 effect sizes. The mean effect size produced over all systems was 0.10 with a standard deviation of 0.41, indicating that, on average, an innovative teaching system in this sample produced one-tenth of a standard deviation better performance than traditional science teaching. Particular kinds of teaching systems, however, produced results that varied from this overall result. Mean effect sizes were also computed by year of publication, form of publication, grade level, and subject matter.