

Mastery learning



Moderate impact for very low cost, based on moderate evidence.

Traditional teaching keeps time spent on a topic constant and allows pupils' 'mastery' of curriculum content to vary. Mastery learning keeps learning outcomes constant but varies the time needed for pupils to become proficient or competent at these objectives.

Mastery learning breaks subject matter and learning content into units with clearly specified objectives which are pursued until they are achieved. Learners work through each block of content in a series of sequential steps and must demonstrate a high level of success on tests, typically about 80%, before progressing to the next unit. Those who do not reach the required level are provided with additional tuition, peer support, small group discussions, or homework, so that they can reach the expected level.

How effective is it?

There are a number of meta-analyses which indicate that, on average, mastery learning approaches are effective, leading to an additional five months' progress.

The effects of mastery learning tend to cluster at two points; two of the meta-analyses show little or no impact, while the rest show an impact of up to six months' additional progress. This variation implies that making mastery learning work effectively is challenging.

Mastery learning appears to be particularly effective when pupils work in groups or teams and take responsibility for supporting each other's progress (see also [Collaborative learning](#) and [Peer tutoring](#)). It also seems to be important that a high bar is set for achievement of 'mastery' (usually 80% to 90% on the relevant test). By contrast, the approach appears to be much less effective when pupils work at their own pace (see also [Individualised instruction](#)).

Mastery learning may also be more effective when used as an occasional or additional teaching strategy: programmes with durations of less than 12 weeks have tended to report a higher impact than longer programmes. Schools may wish to consider using mastery learning for particularly challenging topics or concepts, rather than for all lessons.

Mastery learning appears to be a promising strategy for narrowing the attainment gap. Low-attaining pupils may gain one or two more months of additional progress from this strategy than high-attaining students. Teachers need to plan carefully for how to manage the time of pupils who make progress more quickly.

How secure is the evidence?

The evidence base is of moderate security. There is a large quantity of research on the impact of mastery learning, though much of it is relatively dated and findings are not consistent. In addition, most meta-analyses examining mastery learning use older statistical techniques that may be less accurate.

Despite these potential limitations, the average effect size is consistent with a more recent study in the US, which found that mastery learning approaches can increase learning by six months or more in mathematics for pupils aged 13 to 14.

In February 2015, the Education Endowment Foundation (EEF) published an evaluation of the Mathematics Mastery programme, based on two randomised controlled trials conducted in English schools. It found that, on average, pupils in classes where the approach was used made one additional month's progress compared to similar classes that did not.

It is possible that this lower estimate of progress is more relevant to English schools than some of the older studies. An alternative explanation is that the Mathematics Mastery programme did not include some of the features of programmes that were previously associated with higher impacts. For example, although additional support was provided to struggling pupils, classes did not delay starting new topics until a high level of proficiency had been reached by all pupils.

What are the costs?

Few additional resources are required to introduce a mastery learning approach. Professional development and additional support for staff is recommended, particularly in the early stages of setting up a programme. Estimates are less than £80 per pupil, indicating very low overall costs.

Additional small group tuition and one to one support are also likely to be needed for those pupils who take longer to learn a topic. Many schools will provide this support using existing staff and resources without incurring extra financial cost. However, school leaders should be aware of the extra staff time required and think carefully about other activities they might need to cut back on in order to provide this additional support.

Mastery learning: What should I consider?

Before you implement this strategy in your learning environment, consider the following:

1. Implementing mastery learning is not straightforward. How will you plan for changes and assess whether the approach is successful within your context?
2. A high level of success should be required before pupils move on to new content – how will you monitor and communicate pupil progress?
3. How will you provide opportunities for pupils to take responsibility for helping each other with mastering content?
4. Mastery learning seems to be effective as an additional teaching strategy. How will you decide which topics and concepts are appropriate for a mastery learning approach?
5. How will you provide additional support to pupils who take longer to reach the required level of knowledge for each unit?

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.

Two recent trials in the UK have found positive effects, but at the lower end of the estimates from the meta-analyses.

Additional Cost Information

The main financial cost of implementing a mastery learning approach will be the cost of professional development. The average cost of professional development in EEF-funded programmes is well under £80 per pupil.

The average 'per pupil' cost of the Maths Mastery programme was estimated to be around £131 per year for primary school pupils and around £50 per year for secondary school pupils, in the first year, with per pupil costs likely to reduce in future years in both cases.

Additional one to one and small group support are also likely to be needed. Many schools will provide this support using existing staff and resources. Although this approach will not incur an additional financial cost, school leaders should be aware of the extra staff time required. They must also think carefully about the activity they might have to stop doing in order to provide this additional support.

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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.

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

0 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.

- 1 Slavin, R. E. (1987)
- 3 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.
- 1 Waxman, H. C., Wang, M. C., Anderson, K. A., Walberg, H. J., & Waxman, C. (1985)
- 6 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.
- 1 Willett, J. B., Yamashita, J. J., & Anderson, R. D (1983)
- 8 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.