

## Technical Appendix

### Definition

Individualised instruction can be defined as a teaching system where students work at their own pace on guided personalised activities whilst at school. Various models of individualised instruction have been tried over the years in education, particularly in subjects like mathematics where pupils can have individual sets of activities which they complete, often largely independently. Computer-based and online approaches have also been developed, with more recent 'intelligent tutoring' systems designed to give more tailored feedback and challenges.

Search terms: individualised instruction; self-paced instruction; tailored instruction

### Evidence Rating

There are seven meta-analyses, which indicate that, on average, individualised instruction leads to some improvements in learning. Two of these analyses have been published in the last ten years. Five are more than 30 years old. More than two of these are rigorous, with exploration of methodological and intervention features linked with outcomes. The designs of the studies included in the meta-analyses vary; some have strong causal inference. There is a wide range of average effects across the meta-analyses (from -0.07 to +0.40) for both teacher and technology-focussed studies. Overall the evidence is rated as moderate.

## References

- 1 *Aiello, N.C. & Wolfe, L.M. (Abstract ↓)*  
A Meta-Analysis of Individualized Instruction [↗](#)  
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- 2 *Bangert, R.L., Kulik, J.A., Kulik, C.C. (Abstract ↓)*  
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- 3 *Boden, A., Archwamety, T. & McFarland, M. (Abstract ↓)*  
Programmed Instruction in Secondary Education: A Meta-Analysis of the Impact of Class Size on Its Effectiveness [↗](#)  
Paper presented at the Annual Meeting of the National Association of School Psychologists (New Orleans, LA, March 28-April 1, 2000).  
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- 5 *Flynn, R. J., Marquis, R. A., Paquet, M. P., Peeke, L. M., & Aubry, T. D.*  
Effects of individual direct-instruction tutoring on foster children's academic skills: A randomized trial [↗](#)  
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- 6 *Horak, V.M. (Abstract ↓)*  
A Meta-Analysis of Research Findings on Individualized Instruction in Mathematics [↗](#)  
Journal of Educational Research, 74:4 p 249  
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Small Group and Individual Learning with Technology: A Meta-Analysis [↗](#)  
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- 8 *Ma, W., Adesope, O. O., Nesbit, J. C., & Liu, Q. (Abstract ↓)*  
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- 9 *Slavin R.E. & Karweit, N.L.*  
Effects of Whole Class, Ability Grouped, and Individualized Instruction on Mathematics [↗](#)  
American Educational Research Journal 22:3 pp. 351-367  
(1985)
- 10 *Steenbergen-Hu, S., & Cooper, H. (Abstract ↓)*  
A meta-analysis of the effectiveness of intelligent tutoring systems on K-12 students' mathematical learning [↗](#)  
Journal of Educational Psychology, 105(4), 970  
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- 11 *Willett, J.B., Yamashita, J.J. & R.D. Anderson (Abstract ↓)*  
A Meta-Analysis of Instructional Systems Applied in Science Teaching [↗](#)  
Journal of Research in Science Teaching 20(5):405-17  
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- 12 *Yeh, S.*  
Understanding and addressing the achievement gap through individualized instruction and formative assessment [↗](#)  
Assessment in Education: Principles, Policy & Practice, 17: 2, 169-182  
(2010)

## Summary of effects

Meta-analyses	Effect size	FSM effect size
Aiello, N.C. & Wolfe, L.M., (1980)	0.35	- Science
Bangert, R.L., Kulik, J.A., Kulik, C.C., (1983)	0.10	-
Boden, A., Archwamety, T. & McFarland, M., (2000)	0.40	- (Programmed instruction)
Horak, V.M., (1981)	-0.07	- Mathematics
Ma, W., Adesope, O. O., Nesbit, J. C., & Liu, Q., (2014)	0.41	- (intelligent tutoring systems)
Steenbergen-Hu, S., & Cooper, H., (2013)	0.09	- Mathematics
Willet, J.B., Yamashita, J.J. & R.D. Anderson, (1983)	0.17	- Science
Single Studies	Effect size	FSM effect size
Connor, C. M., Morrison, F. J., Fishman, B., Crowe, E. C., Al Otaiba, S., & Schatschneider, C. (2013)	0.32	-
Flynn, R. J., Marquis, R. A., Paquet, M. P., Peeke, L. M., & Aubry, T. D. (2012)	0.29	-
<b>Median</b>	<b>0.19</b>	

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 *Aiello, N.C. & Wolfe, L.M. (1980)*

Reported are the results of a meta-analysis of 30 studies of individualized instruction in science in which this method was compared with a traditional lecture method of science instruction. Studies analysed also included measurements from which effect sizes could be calculated. Five methods of individualized instruction were identified : (1) audio-tutorial instruction (AT), (2) computer-assisted instruction (CAI), (3) personalized system of instruction (PSI), (4) programmed instruction (PI), and (5) a combination category for studies containing characteristics of individualization but not easily identifiable as one of the previous four methods. On the basis of effect size, individualized instruction appeared to be more effective than the traditional lecture approach for all methods studied. Findings reported were termed preliminary indicating this study was not completed when reported.

### 2 *Bangert, R.L., Kulik, J.A., Kulik, C.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.

### 3 *Boden, A., Archwamety, T. & McFarland, M. (2000)*

This review used meta-analytic techniques to integrate findings from 30 independent studies that compared programmed instruction to conventional methods of instruction at the secondary level. The meta-analysis demonstrated that programmed instruction resulted in higher achievement when compared to conventional methods of instruction (average ES=.40). No significant correlation was found between class size and effect size ( $r=.097, p>=.05$ ). The most important aspect of this meta-analysis is that with this virtually zero correlation, it indicates that programmed instruction maintains its effectiveness over conventional methods of instruction regardless of class size. An appendix contains a data-coding form.

### 6 *Horak, V.M. (1981)*

The present study investigated the effects of individualized instruction on mathematics achievement at the elementary and secondary school levels. The meta-analysis technique developed by Glass was applied to the same sample of studies used by Schoen in his previous voting-method analysis of individualization. The analysis of the 129 effect sizes revealed important trends for the use of self-paced modular instruction in mathematics. This study is also significant in its comparison of the conclusions drawn from a voting-method analysis and Glass's meta-analysis technique.

8 *Ma, W., Adesope, O. O., Nesbit, J. C., & Liu, Q. (2014)*

Intelligent Tutoring Systems (ITS) are computer programs that model learners' psychological states to provide individualized instruction. They have been developed for diverse subject areas (e.g., algebra, medicine, law, reading) to help learners acquire domain-specific, cognitive and metacognitive knowledge. A meta-analysis was conducted on research that compared the outcomes from students learning from ITS to those learning from non-ITS learning environments. The meta-analysis examined how effect sizes varied with type of ITS, type of comparison treatment received by learners, type of learning outcome, whether knowledge to be learned was procedural or declarative, and other factors. After a search of major bibliographic databases, 107 effect sizes involving 14,321 participants were extracted and analyzed. The use of ITS was associated with greater achievement in comparison with teacher-led, large-group instruction ( $g = .42$ ), non-ITS computer-based instruction ( $g = .57$ ), and textbooks or workbooks ( $g = .35$ ). There was no significant difference between learning from ITS and learning from individualized human tutoring ( $g = -.11$ ) or small-group instruction ( $g = .05$ ). Significant, positive mean effect sizes were found regardless of whether the ITS was used as the principal means of instruction, a supplement to teacher-led instruction, an integral component of teacher-led instruction, or an aid to homework. Significant, positive effect sizes were found at all levels of education, in almost all subject domains evaluated, and whether or not the ITS provided feedback or modeled student misconceptions. The claim that ITS are relatively effective tools for learning is consistent with our analysis of potential publication bias.

10 *Steenbergen-Hu, S., & Cooper, H. (2013)*

In this study, we meta-analyzed empirical research of the effectiveness of intelligent tutoring systems (ITS) on K-12 students' mathematical learning. A total of 26 reports containing 34 independent samples met study inclusion criteria. The reports appeared between 1997 and 2010. The majority of included studies compared the effectiveness of ITS with that of regular classroom instruction. A few studies compared ITS with human tutoring or homework practices. Among the major findings are (a) overall, ITS had no negative and perhaps a small positive effect on K-12 students' mathematical learning, as indicated by the average effect sizes ranging from  $g = 0.01$  to  $g = 0.09$ , and (b) on the basis of the few studies that compared ITS with homework or human tutoring, the effectiveness of ITS appeared to be small to modest. Moderator analyses revealed 2 findings of practical importance. First, the effects of ITS appeared to be greater when the interventions lasted for less than a school year than when they lasted for 1 school year or longer. Second, the effectiveness of ITS for helping students drawn from the general population was greater than for helping low achievers. This finding draws attention to the issue of whether computerized learning might contribute to the achievement gap between students with different achievement levels and aptitudes.

11 *Willett, J.B., Yamashita, J.J. & R.D. Anderson (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 the 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.