APPENDIX B

WHAT IS AN EFFECT SIZE?

Reports on educational research use terms such as *meta-analysis* and *effect size* (ES). While these terms are without doubt useful to researchers, they can be confusing and even frustrating for the practitioner. So what does meta-analysis mean exactly? What is an effect size?

A meta-analysis is a summary, or synthesis, of relevant research findings. It looks at all of the individual studies done on a particular topic and summarizes them. This is helpful to educators in that a meta-analysis provides more and stronger support than does a single analysis (meta-analysis is literally an analysis of analyses).

An average effect size tells us about the results across all of the individual studies examined. For example, let's say the purpose of the meta-analysis is to examine multiple studies regarding the effect of clear learning goals on student achievement (that is, the effect of X on Y). An average effect size reports the results of all of the included studies to tell us whether or not clear learning goals improve student achievement and, if so, by how much.

Exactly how does a meta-analysis work, and how is an effect size calculated? Empirical research is highly detailed and often uses idiomatic language; however, in the following steps we have made efforts to demystify the processes of meta-analysis and effect size calculation.

1. *Researchers survey the wide field of educational studies available with an eye for what is relevant to their meta-analysis.* They create keyword lists to help determine the breadth and depth of the search. Published articles, nonpublished articles, dissertations, book chapters, and online and other electronic databases are considered for inclusion. Quite simply, they construct a database of all relevant studies.
2. *After an initial examination of the relevant studies, researchers have an idea of the rigor of each study. They craft their own inclusion criteria by asking which studies are good enough to include and which studies should be excluded*. They also pay close attention to the similarities and differences between the studies. Strong results will be based on

meta-analyses that use studies with common purposes and variables. In other words, researchers want to include the studies that are most analogous. For example, if one study defines student achievement in terms of standardized test scores, and another defines student achievement in terms of students' self-reported learning, researchers would probably not include both studies in the same meta-analysis.

3. *Once researchers have identified the studies they will use for a meta-analysis, they examine the results of each study.* Specifically, they look at the effect sizes of each study in order to mathematically calculate an average effect size (ES) for the overall meta-analysis.

The process behind calculating the ES is quite detailed, but basically, it is computed by determining the difference between the mean of the experimental group (the group that has had the benefit of a particular educational practice), and the mean of the control group (the group that has not had the benefit of a particular educational practice), and then dividing the difference by the standard deviation. In simple terms, a standard deviation is the average distance each score is from the mean. For example, if the mean of a group of scores is 60, and the standard deviation is 5, then the average distance each score is from 60 is 5.

To illustrate how an effect size is computed, let's assume that one class of science students is the experimental group; their class received clear learning goals and took a test on the science content addressed during a specific unit. Another class served as the control group; those students did not receive clear learning goals for that unit and took the same test. The experimental group had a mean (average) score of 85 on the test, and the control group had a mean score of 75. The standard deviation for the test given to both groups was 20. The effect size for this study would be .50 [(85 – 75)/ 20]. This means that the average score in the experimental group is .50 of a standard deviation larger than the mean score of the control group.

An advantage of the effect size is that it can be readily and accurately interpreted in terms of average percentile gain. A percentile gain effectively translates an effect size into a language we can understand. Just how this is done requires a somewhat detailed explanation. Briefly though, an effect size is equivalent to a point on the normal distribution, and once you have a point on the normal distribution, you can determine the expected percentile gain (or loss) for someone at the 50th percentile. Table A.1 lists expected percentile gains for various effect sizes.

If the effect size for use of clear learning goals is .50, for example, a teacher could predict that students in the classroom will improve by 19 percentile points. That is, students scoring at the 50th percentile on achievement tests would be predicted to score at the 69th percentile after clear learning goals had been introduced. In general, the higher the effect size, the better.

When an average effect size is calculated using a number of studies in a meta-analysis, practitioners can be even more sure that the average effect size and its associated percentile gain will be found in classes where the specific educational practice that is the focus of a meta-analysis is being used.

Although terms such as *meta-analysis*, *average effect size*, and *percentile gain* may look daunting at first, they are ultimately employed to gather the widest array of the strongest research and translate the findings into meaningful language for the classroom teacher or school administrator.

Table A.1 Conversion of Effect Size to Percentile Gain

Effect Size	Percentile Gain	Effect Size	Percentile Gain	Effect Size	Percentile Gain	Effect Size	Percentile Gain
		0.5	19	**1**	34	**1.5**	43
0.01	0	**0.51**	19	**1.01**	34	**1.51**	43
0.02	1	**0.52**	20	**1.02**	35	**1.52**	44
0.03	1	**0.53**	20	**1.03**	35	**1.53**	44
0.04	2	**0.54**	21	**1.04**	35	**1.54**	44
0.05	2	**0.55**	21	**1.05**	35	**1.55**	44
0.06	2	**0.56**	21	**1.06**	36	**1.56**	44
0.07	3	**0.57**	22	**1.07**	36	**1.57**	44
0.08	3	**0.58**	22	**1.08**	36	**1.58**	44
0.09	4	**0.59**	22	**1.09**	36	**1.59**	44
0.1	4	**0.6**	23	**1.1**	36	**1.6**	45
0.11	4	**0.61**	23	**1.11**	37	**1.61**	45
0.12	5	**0.62**	23	**1.12**	37	**1.62**	45
0.13	5	**0.63**	24	**1.13**	37	**1.63**	45
0.14	6	**0.64**	24	**1.14**	37	**1.64**	45
0.15	6	**0.65**	24	**1.15**	37	**1.65**	45
0.16	6	**0.66**	25	**1.16**	38	**1.66**	45
0.17	7	**0.67**	25	**1.17**	38	**1.67**	45
0.18	7	**0.68**	25	**1.18**	38	**1.68**	45
0.19	8	**0.69**	25	**1.19**	38	**1.69**	45
0.2	8	**0.7**	26	**1.2**	38	**1.7**	46
0.21	8	**0.71**	26	**1.21**	39	**1.71**	46
0.22	9	**0.72**	26	**1.22**	39	**1.72**	46
0.23	9	**0.73**	27	**1.23**	39	**1.73**	46
0.24	9	**0.74**	27	**1.24**	39	**1.74**	46
0.25	10	**0.75**	27	**1.25**	39	**1.75**	46
0.26	10	**0.76**	28	**1.26**	40	**1.76**	46
0.27	11	**0.77**	28	**1.27**	40	**1.77**	46
0.28	11	**0.78**	28	**1.28**	40	**1.78**	46
0.29	11	**0.79**	29	**1.29**	40	**1.79**	46
0.3	12	**0.8**	29	**1.3**	40	**1.8**	46
0.31	12	**0.81**	29	**1.31**	40	**1.81**	46
0.32	13	**0.82**	29	**1.32**	41	**1.82**	47
0.33	13	**0.83**	30	**1.33**	41	**1.83**	47
0.34	13	**0.84**	30	**1.34**	41	**1.84**	47
0.35	14	**0.85**	30	**1.35**	41	**1.85**	47
0.36	14	**0.86**	31	**1.36**	41	**1.86**	47
0.37	14	**0.87**	31	**1.37**	41	**1.87**	47
0.38	15	**0.88**	31	**1.38**	42	**1.88**	47
0.39	15	**0.89**	31	**1.39**	42	**1.89**	47

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Effect Size	Percentile Gain	Effect Size	Percentile Gain	Effect Size	Percentile Gain	Effect Size	Percentile Gain
0.4	16	**0.9**	32	**1.4**	42	**1.9**	47
0.41	16	**0.91**	32	**1.41**	42	**1.91**	47
0.42	16	**0.92**	32	**1.42**	42	**1.92**	47
0.43	17	**0.93**	32	**1.43**	42	**1.93**	47
0.44	17	**0.94**	33	**1.44**	43	**1.94**	47
0.45	17	**0.95**	33	**1.45**	43	**1.95**	47
0.46	18	**0.96**	33	**1.46**	43	**1.96**	48
0.47	18	**0.97**	33	**1.47**	43	**1.97**	48
0.48	18	**0.98**	34	**1.48**	43	**1.98**	48
0.49	19	**0.99**	34	**1.49**	43	**1.99**	48

Note: Effect sizes over 2.00 correspond to percentile gains of 49%.