Metasynthesis of Preservice Professional Preparation and Teacher Education Research Studies

Supplemental Report

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Metasynthesis of Preservice Professional Preparation and Teacher Education Research Studies: Supplemental Report

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Abstract

The metasynthesis described in Dunst et al. (2018) includes findings for the relationships between 14 sets of preservice and teacher preparation practices and different teaching quality and preschool, K-12 students, university student, and beginning teacher outcomes. This supplemental report includes information about (a) the sources of studies included in the metasynthesis, (b) the types of preservice practices in the studies, (c) the numbers of studies and participants in the studies, (d) the research designs used in the studies, and (e) the definitions or descriptions of the preservice and teacher preparation practice. The supplemental report also includes 22 data tables that were the sources of evidence for investigating preservice practices-outcome measure relationships. All of the information, taken together, provides background information for understanding the methodology and results reported in the metasynthesis.

Introduction

The metasynthesis described in Dunst et al. (2018) evaluated the relationships between 14 sets of preservice teacher preparation practices and different measures of teaching quality and of preschool, K-12 student, university student, and beginning teacher outcomes. The metasynthesis was a meta-analysis of meta-analyses which are also described as second-order meta-analyses (Schmidt & Oh, 2013). Meta-analyses (and select survey studies) were eligible for inclusion if experimental or quasi-experimental studies were the focus of analysis where different preservice practices were compared to business-as-usual (e.g., traditional classroom instruction) or a contrasting or comparative practice (e.g., extensive student teaching vs. limited student teaching). One hundred and eighteen (118) meta-analyses and twelve (12) surveys met the inclusion criteria. The types of preservice practices that were the focus of metasynthesis are shown in Table S-1. Appendix A includes the complete list of research studies in the metasynthesis.

Supplemental Information

The scope of the metasynthesis precluded inclusion of all relevant background information and primary data in the Dunst et al.(2018) report. This supplemental report includes information for understanding the procedures for locating candidate studies; the number of studies, sample sizes, and effect sizes for the different preservice practices-outcome relationships; the research designs used in the meta-analyses and surveys; the definitions of the preservice teacher preparation practices in the metasynthesis; the types of outcome measures used in the meta-analyses and surveys; and the sources of data (effect sizes) for conducting the metasynthesis. Twenty-two (22) data tables were prepared and were the sources of evidence for combining results from different meta-analyses and surveys of the same teacher preparation practices and the same or similar study outcomes.

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Table S-1
Types of Teacher and Preservice Professional Preparation Practices

Teacher Preparation Practices/Variables	Representative Sources
Type of Teacher Degree (High school, associate's degree, child development associate's degree, bachelor's degree, master's degree)	Barnett (2000) Whitebook (2013)
Type of Teacher Preparation Program (Extended degree programs, four year degree programs, bachelor's degree program, master's degree program, integrated degree programs, blended degree programs, etc.)	Breidenstein (2002) Piper (2007) Saracho (2013) Worrell et al. (2014)
Type of Teacher Certification (Traditional teacher certification, National Board Certification, Teach for America Certification, alternative teacher certification, etc.)	Darling-Hammond et al. (2001) Stayton et al. (2012)
In-Field Degree/Certification (In-field certification or degree; out-of-field certification or degree)	du Plessis (2017) Ingersoll & Gruber (1996)
Type of Coursework (General education, subject matter courses, methods courses, etc.)	Akarsu & Kay (2012) Clift & Brady (2005) Isikoglu (2008)
Methods of Course Delivery (Distance education courses, blended courses, personalized system of instruction courses, etc.).	Castle & McGuire (2010) Clift & Brady (2005)
Web- and Technology-Based Assisted Instruction (Technology-assisted instruction, computer-assisted instruction, web-based instruction, virtual reality instruction, etc.)	Mandinach & Cline (2013) Wasim et al. (2014)
Course-Based Student Learning Methods (Problem-based learning, case-based learning, project-based learning, self-directed learning, guided design, etc.)	Levin (1995) Prince & Felder (2007)
Cooperative Learning Practices (Small group learning, peer tutoring, peer instruction, etc.)	Johnson & Johnson (1999) Slavin (1996) Tosey & Gregory (1998)
Faculty Instructional Practices (Faculty coaching, just-in-time training, faculty mentoring, etc.)	Gormally et al. (2014) Greenwald (1997)
Teaching Method Instruction (Microteaching, simulation-based instruction, mini courses, peer-facilitated instruction, etc.)	Donnely & Fitzmaurice (2011) Katz (1999) DeNeve & Heppner (1997) Sen (2009)
Types of Field Experiences (Student teaching, practicum experience, course-based field experiences, service learning, etc.)	Baeten & Simons (2014) Clift & Brady (2005) Darling-Hammond (2006) Guise et al. (2017)
Field Experience Supervision (Clinical supervision, field-based performance feedback, etc.)	Burns et al. (2016) Darling-Hammond (2014)
Induction and Mentoring (School-based induction, school-based mentoring, beginning teacher coaching, etc.)	Howe (2006) Kemmis et al. (2014) Strong (2009)

Sources of Candidate Meta-Analyses and Surveys

The search for candidate research reports included traditional electronic databases (ERIC, ProQuest Central, PsycInfo, etc.) and nontraditional sources (e.g., Directory of Open Access Journals, Bielefeld Academic Search Engine); the reference lists of all located papers on preservice teacher preparation; electronic searches of those as well as other papers of preservice teacher preparation for meta-analysis and research syntheses; searches of bibliographies of preservice and teacher preparation practices; and searches of more than 100 journals publishing meta-analyses of preservice professional development and teacher preparation meta-analyses. Appendix B includes the complete list of journals searched for candidate meta-analyses.

Meta-Analyses and Surveys

Appendix C-1 lists the meta-analyses included in the metasynthesis; the sources of the meta-analyses; the particular type of preservice practices or variables that was the focus of investigation (Table S-1); the number of studies included in the meta-analyses; the total sample size for the studies in the meta-analyses; and the total number of effect sizes for preservice teacher preparation-outcome relationships. Many of the meta-analyses did not include either or both the number of studies or sample sizes in the meta-analyses. The numbers reported (studies and sample sizes) therefore are the minimum numbers available to report in the metasynthesis. The numbers of effect sizes are those included in the metasynthesis or which were computed for the preservice teacher preparation-outcome relationships by our Institute Data Analyst.

The sources of the surveys included the metasynthesis, the preservice teacher preparation practices, sample sizes, and numbers of effect sizes are shown in Appendix C-2. Surveys were included when none or only a few meta-analyses were located for particular preservice teacher preparation practices or when the surveys included results for particular practice-outcome relationships not included in the meta-analyses.

Research Designs and Comparisons

Appendix D shows the types of comparisons that were made in the studies in the meta-analyses and surveys. The majority of research reports included post-test only between group comparisons of a teacher preparation practice with a contrasting condition (most often business-as-usual). A number of meta-analyses included between group comparisons of pretest-posttest change or difference scores.

Particular types of preservice teacher preparation practices (e.g., number of methods courses, class attendance) were not amendable to between group comparisons. In those meta-analyses, the correlations between the preservice practices measures and study outcomes were converted to mean difference effect sizes for the metasynthesis.

A number of meta-analyses included a combination of between group comparisons and pretest-posttest comparisons. These meta-analyses were included only if the majority of studies in a meta-analysis included between group comparisons, the meta-analysts determined that the two types of studies yielded similar sizes of effects, or the meta-analysts explicitly stated that the majority of studies included between group comparisons.

Study Participants

The majority of meta-analyses included only university students or beginning teachers. In cases where meta-analyses included both university students and other participants, and the results we reported separately for subsamples of participants, we included the results for only university students. In those cases where results for subsamples of participants not reported separately, we included the full samples but indicated the percent of participants who were university students or the percent of studies that included only university students. In a small number of meta-analyses, the investigators indicated that the majority of participants were university students but did not indicate which percent of the samples or percent of studies only were university students.

Teacher and Preservice Preparation Practices

The definitions or descriptions of the preservice teacher preparation practices are included in Appendix E. They are organized according to the 14 different preservice practices in Table S-1with each type of practice including the definition or description of the specific preservice practice or variable that was the focus of metasynthesis.

In those cases where a meta-analysis or survey included an explicit definition of a preservice practice or variable, we simply cited the best example of the definition or description. In those cases where different definitions or descriptions were used by different meta-analysts, we developed definitions or descriptions of the preservice practice so that they included the key features and elements of a practice. In some cases, meta-analysts adopted definitions of particular practices proposed by others which are cited in Appendix E.

Study Outcome Measures

Table S-2 shows how the outcome measures were categorized for data analysis purposes. The study outcomes were categorized as either teaching quality measures or child, K-12 student, university student, or beginning teacher outcomes. Teaching quality was measured in terms of classroom quality, instructional (teaching) practices, and teacher belief appraisals (e.g., teacher preparedness). Student and teacher outcomes were measured in terms of different performance (e.g., achievement) and different belief appraisal (e.g., satisfaction with a course delivery method) measures.

The two sets of belief measures differed in terms of targets of appraisals. Teaching quality belief measures all included student or beginning teacher appraisals of his or her own behavior or practices (e.g., teacher self-efficacy beliefs). Participant belief measures all included appraisals of others' practices or behaviors and primarily course instructors, mentors, and supervisors (e.g., attitudes toward course methods).

Table S-2
Categorization of the Meta-Analysis and Survey Outcomes for Performing the Metasynthesis

Outcome Categories	Examples of Study Outcomes
Teaching Quality	
Teaching Behaviors	Classroom Quality, Teaching Practices, Teacher Performance, Instructional Practices, Classroom Management
Belief Appraisals	Self-Efficacy Beliefs, Teacher Preparedness, Commitment to Teaching, Affect
Participant Outcomes	
Performance Measures	Achievement, Knowledge Acquisition, Skill Development, Course Grades
Belief Appraisals	Satisfaction with, Attitudes toward, Ratings of Course Quality

Teaching quality included different measures of student or beginning teacher behavior practices and different measures of student or beginning teacher beliefs about his or her ability to engage in teaching-related practices (e.g., teacher preparedness, commitment to teaching) or attitudes toward, satisfaction with, or positive affect while engaged in teaching-related practices.

Preschool, K-12 students, university student, and beginning teacher outcomes included both direct and proxy measures of participant performance. The particular measures used in the meta-analyses and surveys were quite varied, but taken together, constituted measures of some type of performance. The participant belief measures were much more similar and included satisfaction with preservice practices, attitudes toward preservice practices, and ratings or judgments of preservice practice quality.

Data Tables

The results reported in the meta-analyses and surveys, or results computed by the metasynthesis investigators, were used to construct 22 data tables for each of the 14 sets of preservice teacher preparation practices (Table S-1) and the different outcomes for each set of practices or variables. Each data table for each set of preservice practices in Table S-1 includes the citation for the study, type of research report (meta-analysis or survey), the between group or comparative conditions, the outcome measures in the studies, the grade level for the outcome measures, number of studies, sample sizes, number of effect sizes, average effect sizes for each type of practice-outcome relationship, the 95% confidence interval for the average effect sizes, the Z test for the effect sizes, and the p-value for the average effect sizes. An attempt was made to include or compute all of this information and statistics, but because of missing data, it was not possible to construct data tables with complete sets of information for all practices for all studies. All of the data tables, however, include the number of effect sizes and average effect sizes for every preservice practice-outcome relationship which were the focus of the metasynthesis.

Data Preparation and Analysis

The preservice teacher preparation practices and sizes of the effects for the same or very similar outcomes in Tables S-3 to S-24 were first examined to determine which results from which studies could be combined to compute overall sizes of effects for the practices. This was done because inspection of the data tables found that certain practices were differentially related to the study outcomes, and in other cases variations of the same practice were not differentially related to the study outcomes. Several examples are provided to illustrate the decision-making rule.

Simulation-based instruction (SBI) was evaluated in a number of meta-analyses that involved either no additional practices (e.g., Cook et al., 2013; Kim, Park, & Shin, 2016) or SBI with deliberate practice (McGaghie, Issenberg, Cohen, Barsuk, & Wayne, 2011). The size of effect for SBI including deliberate practice (McGaghie et al., 2011) was considerably larger than the effect sizes in the Cook et al. (2013) and Kim et al. (2016) meta-analyses, whereas there were no discernible differences in the SBI used in the studies in the later two meta-analyses. Therefore, the McGaghie et al. (2011) SBI was considered a different kind of practice compared to the practices in the other two meta-analyses. In contrast, Merchant et al. (2014) investigated the use of virtual reality instruction (VRI) with three different kinds of content and found similar sizes of effect for all three practice variations. The effect sizes for the different variations of VRI were therefore combined for determining the overall effect for VRI.

The decision-making rule was applied to all practices in all data tables for determining which preservice teacher preparation practices were combined or treated separately in the metasynthesis. After this process was completed, the procedures described in Dunst et al. (2018) were used to identify core and high leverage teacher preparation practices.

Conclusion

The methods and results described in Dunst et al. (2018) together with the information in this supplemental report provides readers with all of the material needed to understand the location of candidate studies (meta-analyses and surveys), the types of preservice and teacher preparation practices constituting the focus of investigation, the methods used to code both the independent and dependent variables, and data aggregation and analysis. All of the appendices as well as the data tables in this supplemental report include information for readers to understand the "start to finish" in terms of the purpose, focus, and outcomes from the metasynthesis.

Table S-3

Relationships Between Type of Teacher Degrees and Teaching Quality

Study	Type of Study	Comparison	Grade	Teaching Quality	Studies	Sample Size	*k*	Effect Size	95% CI	*Z*-test	*p*-value
Manning et al. (2017)	MA	>HS vs. <=HS	P	Classroom quality	2	132	2	.72	.35, 1.09	3.81	.0001
Early et al. (2007)[a]	MS	AA vs. HS	P	Classroom quality	6	1146	6	.01	-.12, .13	.11	.9126
Manning et al. (2017)	MA	CDA vs. <CDA	P	Classroom quality	1	133	1	-.02	-.36, .33	.09	.9275
Manning et al. (2017)	MA	AA vs. <CDA	P	Classroom quality	1	106	1	.25	-.14, .64	1.24	.2157
Kelley & Camilli (2007)	MA	BA vs. HS	P	Classroom quality	8	1880	15	.42	.26, .58	5.25	.0000
Early et al. (2007)	MS	BA vs. HS	P	Classroom quality	6	1560	6	.11	.00, .22	2.03	.0424
Kelley & Camilli (2007)	MA	BA vs. HS	P	Teacher/child interactions	8	2224	55	.54	.40, .68	7.71	.0000
Kelley & Camilli (2007)	MA	BA vs. HS	P	Instructional practices	3	499	11	.40	.20, .60	4.00	.0001
Kelley & Camilli (2007)	MA	BA vs. HS	P	Teacher beliefs	4	550	11	.77	.57, .97	7.70	.0000
Early et al. (2007)	MS	BA vs. AA	P	Classroom quality	7	1832	7	.07	-.04, .17	1.27	.2050
Manning et al. (2017)	MA	BA vs. <CDA	P	Classroom quality	1	413	1	.11	-.08, .31	1.13	.2568
Manning et al. (2017)	MA	BA vs. <BA	P	Classroom quality	4	644	4	.33	.17, .49	4.06	.0000

NOTES. MA = Meta-analysis, MS = Multiple sample study, and NS = National survey. HS = High school, AA = Associates degree, CDA = Child development associates degree, BA = Bachelor's degree, and MA = Master's degree. P = Preschool and K-12 = Kindergarten to 12th grade.
k = Number of effect sizes and CI = Confidence interval.

[a]The data in the Early et al. (2007) report were meta-analyzed for the metasynthesis.

Table S-3, continued.

Study	Type of Study	Comparison	Grade	Teaching Quality	Studies	Sample Size	*k*	Effect Size	95% CI	*Z*-test	*p*-value
Gong (2015)	NS	BA+ vs. AA	P	Interactional practices	1	4300	1	.33	.27, .39	10.63	.0000
Gong (2015)	NS	BA+ vs. AA	P	Teacher sensitivity	1	4300	1	.34	.28, .41	11.13	.0000
Gong (2015)	NS	BA+ vs. AA	P	Interactional practices	1	4300	3	.24	.21, .28	13.71	.0000
Early et al. (2007)[a]	MS	MA vs. HS	P	Classroom quality	6	1066	6	.23	.10, .36	3.46	.0005
Manning et al. (2017)	MA	MA vs. CDA	P	Classroom quality	1	129	1	.45	.09, .81	2.46	.0140
Early et al. (2007)	MS	MA vs. AA	P	Classroom quality	7	1195	7	.17	.05, .28	2.78	.0054
Early et al. (2007)	MS	MA vs. BA	P	Classroom quality	7	1759	7	.16	.05, .26	2.98	.0029

NOTES. MA = Meta-analysis, MS = Multiple sample study, and NS = National survey. HS = High school, AA = Associates degree, CDA = Child development associates degree, BA = Bachelor's degree, MA = Master's degree. P = Preschool and K-12 = Kindergarten to 12th grade.
k = Number of effect sizes and CI = Confidence interval.

[a]The data in the Early et al. (2007) report were meta-analyzed for the metasynthesis.

Table S-4

Relationships Between Type of Teacher Degrees and Child and Student Outcomes

Study	Type of Study	Comparison	Grade	Child/Student Outcomes	Studies	Sample Size	*k*	Effect Size	95% CI	*Z*-test	*p*-value
Early et al. (2007)[a]	MS	AA vs. HS	P	Receptive language	6	1734	6	-.06	-.16, .04	-1.14	.2536
Early et al. (2007)	MS	AA vs. HS	P	Pre-reading	6	1734	6	-.01	-.11, .09	-0.21	.8319
Early et al. (2007)	MS	AA vs. HS	P	Mathematics	6	1734	6	.03	-.07, .13	.64	.5231
Early et al. (2007)	MS	BA vs. HS	P	Mathematics	6	2713	6	.06	-.02, .15	1.42	.1568
Kelley & Camilli (2007)	MA	BA vs. HS	P	Cognitive development	3	429	4	.50	.07, .93	2.27	.0232
Early et al. (2007)	MS	BA vs. HS	P	Receptive language	6	2713	6	.00	-.09, .08	-0.10	.9188
Kelley & Camilli (2007)	MA	BA vs. HS	P	Social development	3	194	9	.17	.05, .29	2.83	.0046
Early et al. (2007)	MS	BA vs. HS	P	Pre-reading	6	2713	6	.06	-.02, .15	1.46	.1431
Early et al. (2007)	MS	MA vs. HS	P	Mathematics	6	1727	6	.04	-.06, .14	.76	.4445
Early et al. (2007)	MS	MA vs. HS	P	Receptive language	6	1727	6	.04	-.06, .14	.76	.4499
Early et al. (2007)	MS	MA vs. HS	P	Pre-reading	6	1727	6	.09	-.01, .19	1.84	.0652
Falenchuk et al. (2017)	MA	BA vs. AA+	P	Letter word identification	2	3508	2	.09	.01,.16	2.19	.0283
Falenchuk et al. (2017)	MA	BA vs. AA+	P	Applied problems	2	3508	2	.09	-.03, .20	1.41	.1590
Falenchuk et al. (2017)	MA	BA+ vs. AA+	P	Vocabulary	3	7265	3	.08	.04, .12	3.43	.0006
Early et al. (2007)	MS	BA vs. AA	P	Receptive language	7	3385	7	.04	-.04, .12	1.01	.3118
Early et al. (2007)	MS	BA vs. AA	P	Pre-reading	6	2819	6	.08	.00, .16	1.89	.0584
Early et al. (2007)	MS	BA vs. AA	P	Mathematics	7	3385	7	.02	-.06, .09	0.42	.6716
Gong (2015)	NS	BA+ vs. AA	P	Mathematics	1	4100	1	.22	.16, .28	6.89	.0000
Gong (2015)	NS	BA+ vs. AA	K	Mathematics	1	3400	1	.22	.15, .29	6.27	.0000
Early et al. (2007)	MS	MA vs. AA	P	Pre-reading	6	1833	6	.11	.01, .20	2.25	.0248
Early et al. (2007)	MS	MA vs. AA	P	Receptive language	7	1983	7	.06	-.03, .15	1.23	.2185

bNOTES. MA = Meta-analysis, MS = Multiple sample study, and NS = National survey. HS = High school, AA = Associate's degree, BA = Bachelor's degree, and MA = Master's degree. P = Preschool, K = Kindergarten, and K-12 = Kindergarten to 12th grade. *k* = Number of effect sizes and CI = Confidence interval.

[a]The data in the Early et al. (2007) report were meta-analyzed for the metasynthesis.

Table S-4, continued.

Study	Type of Study	Comparison	Grade	Child/Student Outcomes	Studies	Sample Size	*k*	Effect Size	95% CI	*Z*-test	*p*-value
Early et al. (2007)[a]	MS	MA vs. AA	P	Mathematics	7	1983	7	-.01	-.10, .08	-.15	.8807
Early et al. (2007)	MS	MA vs. BA	P	Receptive language	7	3398	7	.05	-.03, .12	1.19	.2340
Early et al. (2007)	MS	MA vs. BA	P	Pre-reading	6	2812	6	.07	-.01,.15	1.67	.0955
Early et al. (2007)	MS	MA vs. BA	P	Mathematics	7	3398	7	.01	-.07, .08	0.22	.8268
Greenwald et al. (1996)	MA	MA+ vs. BA	K-12	Student achievement	8	-	15	.09	-	-	-

NOTES. MA = Meta-analysis, MS = Multiple sample study, and NS = National survey. HS = High school, AA = Associate's degree, BA = Bachelor's degree, and MA = Master's degree. P = Preschool, K = Kindergarten, and K-12 = Kindergarten to 12th grade. *k* = Number of effect sizes and CI = Confidence interval.

[a]The data in the Early et al. (2007) report were meta-analyzed for the metasynthesis.

Table S-5

Relationships Between Type of Teacher Preparation Program, Teaching Quality and Teacher Beliefs

Study	Type of Study	Comparison	Grade	Teacher Outcomes	Studies	Sample Size	*k*	Effect Size	95% CI	*Z*-test	*p*-value
Baker & Andrew (1993); Andrew & Schwab (1995)	NS	5 vs. 4	CE	Teaching quality	1	1394	3	-.12	-	-	-
Baker & Andrew (1993); Andrew & Schwab (1995)	NS	5 vs. 4	CE	Instructional practices	1	1394	1	.12	-	-	-
Baker & Andrew (1993); Andrew & Schwab (1995)	NS	5 vs. 4	CE	Independent thinking practices	1	1394	5	.00	-	-	-
Baker & Andrew (1993); Andrew & Schwab (1995)	NS	5 vs. 4	CE	Discovery learning practices	1	1394	3	-.20	-	-	-
Baker & Andrew (1993); Andrew & Schwab (1995)	NS	5 vs. 4	CE	Direct instruction practices	1	1394	2	.09	-	-	-
Baker & Andrew (1993); Andrew & Schwab (1995)	NS	5 vs. 4	CE	Commitment to teaching	1	1394	4	.01	-	-	-
Baker & Andrew (1993); Andrew & Schwab (1995)	NS	5 vs. 4	CE	Attitudes toward student motivation	1	1394	1	-.15	-	-	-
Baker & Andrew (1993); Andrew & Schwab (1995)	NS	5 vs. 4	CE	Beliefs about student attitudes	1	1394	2	-.17	-	-	-
Thomas & Loadman (2001)	NS	EP vs. BA	CE	Preparedness	1	3875	1	.15	-	-	-
Thomas & Loadman (2001)	NS	EP vs. BA	CE	Performance	1	3870	1	.17	-	-	-
Thomas & Loadman (2001)	NS	EP vs. BA	CE	Knowledge	1	3733	1	.22	-	-	-
Thomas & Loadman (2001)	NS	EP vs. BA	CE	Career satisfaction	1	2294	1	-.08	-	-	-

NOTES. NS = National survey. 5 = Five year (extended) degree program, 4 = Four year degree program, EP = Extended preparation program graduate and BA = Bachelors degree. CE = Career educator. *k* = Number of effect sizes and CI = Confidence interval.

[a]The data in the Early et al. (2007) report were meta-analyzed for the metasynthesis.

Table S-6

Relationships Between Type of Teacher Certification or Degree and Child and Student Outcomes

Study	Type of Study	Comparison	Grade	Child/Student Outcomes	Studies	Sample Size	*k*	Effect Size	95% CI	*Z*-test	*p*-value
Early et al. (2007)	MS	ECE vs. NC	P	Receptive language	6	1267	6	.00	-.12, .12	-0.03	.9749
Early et al. (2007)	MS	OTC vs. NC	P	Receptive language	5	1042	5	.00	-.12, .13	.06	.9518
Early et al. (2007)	MS	OTC vs. NC	P	Pre-reading	4	659	4	.08	-.09, .24	.91	.3606
Early et al. (2007)	MS	ECE vs. NC	P	Mathematics	6	1267	6	-.01	-.13, .11	-.19	.8519
Early et al. (2007)	MS	OTC vs. NC	P	Mathematics	5	1042	5	-.05	-.18, .07	-.84	.4023
Whitford et al. (2018)	MA	AC vs. TC	K-5	English/ELA/reading achievement	-	-	9	.00	-.14, .14	.00	.9910
Whitford et al. (2018)	MA	TAC vs. TC	K-5	English/ELA/reading achievement	-	-	6	.02	-.01, .06	1.48	.1389
Whitford et al. (2018)	MA	TAC+AC vs. TC	K-5	English/ELA/reading achievement	7	-	15	.01	-.02, .04	.86	.3914
Whitford et al. (2018)	MA	AC vs. TC	K-5	Math achievement	-	-	7	.04	-.05, .12	.89	.3751
Whitford et al. (2018)	MA	TAC vs. TC	K-5	Math achievement	-	-	6	.08	.04, .12	4.00	
Whitford et al. (2018)	MA	TAC+AC vs. TC	K-5	Math achievement	7	-	13	.04	.00, .08	2.74	
Whitford et al. (2018)	MA	AC vs. TC	6-8	English/ELA/reading achievement	-	-	12	.53	.12, .93	2.54	.0110

NOTES. MA = Meta-analysis, MS = Multiple sample study, and NS = National survey. ECE = Early childhood education, OTC = Out-of-field teacher education certification or degree, NBC = National board teacher certification, TAC = Teach for America teacher certification, TC = Traditional or standard teacher certification, AC = Alternative teacher certification, PTC = Probationary or provisional teacher certification, ETC = Emergency or temporary teacher certification, NTC = Nonspecified teacher certification, and NC = Not certified. P = Preschool, K-5 = Kindergarten to 5th grade, 3-8 = Grades 3 to 8, 6-8 = Grades 6 to 8, and K-12 = Kindergarten to 12th Grade. *k* = Number of effect sizes and CI = Confidence interval.

[a]The data in the Early et al. (2007) report were meta-analyzed for the metasynthesis.

Table S-6, continued.

Study	Type of Study	Comparison	Grade	Child/Student Outcomes	Studies	Sample Size	*k*	Effect Size	95% CI	*Z*-test	*p*-value
Whitford et al. (2018)	MA	TAC vs. TC	6-8	English/ELA/reading achievement	1	-	1	.02	.00, .04	3.60	.0003
Whitford et al. (2018)	MA	AC vs. TC	6-8	Math achievement	-	-	28	.14	.00, .29	1.95	.0513
Whitford et al. (2018)	MA	TAC vs. TC	6-8	Math achievement	1	-	1	.12	.08, .16	6.00	.0000
Whitford et al. (2018)	MA	TAC+AC vs. TC	6-8	English/ELA/reading achievement	4	-	13	.11	.02, .19	2.43	.0151
Whitford et al. (2018)	MA	TAC+AC vs. TC	6-8	Math achievement	4	-	29	.12	.02, .22	2.29	.0220
Qu & Becker (2003)	MA	AC vs. TC	K-12	Student achievement	6	-	23	.05	.03, .06	5.56	.0000
Qu & Becker (2003)	MA	TC vs. ETC	K-12	Student achievement	3	-	30	.19	.10, .28	4.32	.0000
Qu & Becker (2003)	MA	TC vs. NC	K-12	Student achievement	4	-	8	.39	.29, .49	7.36	.0000
Hacke (2010)	MA	NBC vs. NC	K-12	Reading achievement	9	942370	9	.09	.08, .10	18.00	.0000
Hacke (2010)	MA	NBC vs. TC	K-12	Math achievement	12	1047391	12	.08	.07, .10	8.00	.0000
Whitford et al. (2018)	MA	AC vs. TC	9-12	Math achievement	-	-	10	-.18	-.46, .10	1.28	.2010
Whitford et al. (2018)	MA	AC vs. TC	9-12	English/ELA/reading achievement	1	-	1	.00	-.02, .02	.00	.9999
Whitford et al. (2018)	MA	TAC vs. TC	9-12	English/ELA/reading achievement	-	-	3	-.03	-.09, .03	1.00	.3154

NOTES. MA = Meta-analysis, MS = Multiple sample study, and NS = National survey. ECE = Early childhood education, OTC = Out-of-field teacher education certification or degree, NBC = National board teacher certification, TAC = Teach for America teacher certification, TC = Traditional or standard teacher certification, AC = Alternative teacher certification, PTC = Probationary or provisional teacher certification, ETC = Emergency or temporary teacher certification, NTC = Nonspecified teacher certification, and NC = Not certified. P = Preschool, K-5 = Kindergarten to 5th grade, 3-8 = Grades 3 to 8, 6-8 = Grades 6 to 8, and K-12 = Kindergarten to 12th Grade. *k* = Number of effect sizes and CI = Confidence interval.

[a]The data in the Early et al. (2007) report were meta-analyzed for the metasynthesis.

Table S-6, continued.

Study	Type of Study	Comparison	Grade	Child/Student Outcomes	Studies	Sample Size	*k*	Effect Size	95% CI	*Z*-test	*p*-value
Whitford et al. (2018)	MA	TAC vs. TC	9-12	Math achievement	-	-	7	.06	-.01, .12	1.75	.0790
Whitford et al. (2018)	MA	TAC+AC vs. TC	9-12	English/ELA/reading achievement	-	-	4	-.02	-.07, .03	.92	.3591
Whitford et al. (2018)	MA	TAC+AC vs. TC	9-12	Math achievement	7	-	17	-.01	-.07, .05	.21	.8321

NOTES. MA = Meta-analysis, MS = Multiple sample study, and NS = National survey. ECE = Early childhood education, OTC = Out-of-field teacher education certification or degree, NBC = National board teacher certification, TAC = Teach for America teacher certification, TC = Traditional or standard teacher certification, AC = Alternative teacher certification, PTC = Probationary or provisional teacher certification, ETC = Emergency or temporary teacher certification, NTC = Nonspecified teacher certification, and NC = Not certified. P = Preschool, K-5 = Kindergarten to 5th grade, 3-8 = Grades 3 to 8, 6-8 = Grades 6 to 8, and K-12 = Kindergarten to 12th Grade. *k* = Number of effect sizes and CI = Confidence interval.

[a]The data in the Early et al. (2007) report were meta-analyzed for the metasynthesis.

Table S-7

Relationships Between In-Field Certification or Degree and Teaching Quality

Study	Type of Study	Comparison	Grade	Teaching Quality	Studies	Sample Size	*k*	Effect Size	95% CI	*Z*-test	*p*-value
Early et al. (2007)[a]	MS	IFC vs. OTE	P	Classroom quality	5	636	5	-.01	-.17, .15	-0.08	.9336
Early et al. (2007)	MS	IFC vs. NC	P	Classroom quality	6	578	6	-.05	-.22, .13	-0.55	.5797
Early et al. (2007)	MS	IFC vs. NC	P	Classroom quality	5	450	5	-.05	-.24, .14	-0.52	.6015
Qu & Becker (2003)	MA	IFC vs. AC	K-12	Teacher performance	8	-	17	.05	-.02, .12	1.39	.0823
Qu & Becker (2003)	MA	IFC vs. EC	K-12	Teacher performance	7	-	22	.05	-.03, .13	1.28	.1003

NOTES. MA = Meta-analysis and MS = Multiple sample study. IFC = In-field teacher certification/degree, OTE = Out-of-field teacher education certification or degree, AC = Alternative teacher certification, EC = Emergency teacher certification, and NC = Not certified. P = Preschool and K-12 = Kindergarten to 12th Grade. *k* = Number of effect sizes and CI = Confidence interval.

[a]The data in the Early et al. (2007) report were meta-analyzed for the metasynthesis.

Table S-8

Relationships Between In-Field Certification or Degree on Child and Student Outcome

Study	Type of Study	Comparison	Grade	Child/Student Outcomes	Studies	Sample Size	*k*	Effect Size	95% CI	*Z*-test	*p*-value
Early et al. (2007)[a]	MS	IFC vs. OFC	P	Receptive language	5	1513	5	-.02	-.12, .08	-0.30	.7643
Early et al. (2007)	MS	IFC vs. OFC	P	Pre-reading	4	885	4	-.02	-.15, .11	-.32	.7463
Early et al. (2007)	MS	IFC vs. OFC	P	Pre-reading	5	742	5	.06	-.09, .21	.76	.4467
Early et al. (2007)	MS	IFC vs. OFC	P	Mathematics	5	1513	5	.04	-.07, .14	.69	.4892
Early et al. (2007)	MS	IFC vs. NTC	P	Receptive language	6	1267	6	.00	-.12, .12	-0.03	.9749
Sparks (2004)	NS	IFC vs. OFC	6-8	Math achievement	1	569	1	.37	.21, .54	4.40	.0000
Sparks (2004)	NS	IFC vs. OFC	9-12	Math achievement	1	44	1	.17	-.44, 1.21	.55	.2924

NOTES. MS = Multiple sample study and NS = National survey. IFC = In-field teacher certification/degree, OFC = Out-of-field teacher certification/degree, and NTC = No teacher certification. P = Preschool, 6-8 = Grades 6 to 8, 9-12 = Grades 9 to 12, and 12 = 12th grade. *k* = Number of effect sizes and CI = Confidence interval.

[a]The data in the Early et al. (2007) report were meta-analyzed for the metasynthesis.

Table S-9

Relationships Between the Coursework Measures and Teaching Quality

Study	Type of Study	Comparison	Grade	Teaching Quality	Studies	Sample Size	*k*	Effect Size	95% CI	*Z*-test	*p*-value
Ronfeldt et al (2014)	NS	MC	K-5	Instructional preparedness	1	1084	1	.06	-.06,.17	1.82	.0688
Ronfeldt et al (2014)	NS	MC	6-8	Instructional preparedness	1	472	1	.01	-.17, .19	.25	.8026
Ronfeldt et al (2014)	NS	MC	9-12	Instructional preparedness	1	1221	1	.01	-.10, .12	.38	.7077
Druva & Anderson (1983)	MA	GEC	K-12	Teaching effectiveness	-	-	3	.80	-	-	-
Anderson et al. (1982)	MA	SC	K-12	Teaching effectiveness	-	-	5	-.08	-	-	-

NOTES. MA = Meta-analysis and NS = National survey. GEC = Number of general education courses, MC = Number of methods courses, and SC = Number of science courses. K-5 = Kindergarten to grade 5, 6-8 = Grades 6 to 8, 9-12 = Grades 9 to 12, and K-12 = Kindergarten to 12th grade. *k* = Number of effect sizes and CI = Confidence intervals.

Table S-10

Relationships Between the Coursework Measures and Student Outcomes

Study	Type of Study	Comparison	Grade	Student Outcomes	Studies	Sample Size	*k*	Effect Size	95% CI	*Z*-test	*p*-value
Monk (1994) (UC)	NS	SMC	10	Math achievement	1	1492	1	.03	-.07, .14	1.33	.1835
Monk (1994) (GC)	NS	SMC	10	Math achievement	1	1492	1	.04	-.06, .14	1.43	.1527
Monk (1994) (GC)	NS	MC	10	Math achievement	1	1492	1	.02	-.09, .12	.60	.5485
Monk (1994) (UC)	NS	SMC	11	Math achievement	1	983	1	.07	-.05, .20	2.33	.0198
Monk (1994) (GC)	NS	SMC	11	Math achievement	1	983	1	-.02	-.14, .11	.56	.5823
Monk (1994) (GC)	NS	MC	11	Math achievement	1	983	1	.05	-.08, .17	1.42	.1556
Permzadian & Crede (2016)	MA	FYS vs. NSS	U	First-year GPA	89	52406	89	.02	-.25, .29	.14	.8887
Crede et al. (2010)	MA	CA(S)	U	Academic performance	11	8524	11	1.12	1.06, 1.19	-	-
Crede et al. (2010)	MA	CA(N)	U	Academic performance	57	12640	57	.90	.87, .93	-	-

NOTES. MA = Meta-analysis and NS = National survey. MC = Number of methods courses, SMC = Number of subject matter courses, CA = Class attendance, FYS = First year college/university seminars and NSS=No student seminars. G = General education courses, S = Science courses and N = Nonscience courses. UC = Undergraduate courses and GC = Graduate courses. 10 = Grade 10, 11 = Grade 11, and U = Undergraduate students. *k* = Number of effect sizes and CI = Confidence interval.

Table S-11

Relationships Between Method of Course Delivery and University Student Outcomes

Study	Type of Study	Comparison	Grade	Student Outcomes	Studies	Sample Size	*k*	Effect Size	95% CI	*Z*-test	*p*-value
Jahng et al. (2007)	MA	DEC vs. TCI	U	Final course grade	20	1617	20	.02	.08, .13	.44	.6566
Shachar & Neumann (2010)	MA	DEC vs. TCI	U	Final course grade	125	20800	125	.26	.17, .35	5.58	.0000
Bernard et al. (2004)	MA	DEC vs. TCI	U	Final course grade	-	-	219	-.01	-.03, .02	.38	.7043
Roberts (2011)	MA	DEC vs. TCI	U (66)[a]	Course grades	59	4350	86	.78	.62, .93	9.95	.0000
M. Allen et al. (2004)	MA	DEC vs. TCI	U(NS)[b]	Course grades	28	71731	39	.10	-	-	-
M. Allen et al. (2002)	MA	DEC vs. TCI	U(NS)[b]	Satisfaction with course	4	674	5	.06	-	-	-
Zhao et al. (2005)	MA	DEC vs. TCI	U	Composite measure		-	36	.36	.29, .43	10.08	.0000
Williams (2004)	MA	DEC vs. TCI	U	Academic achievement	25	1322	34	.15	.07, .23	3.66	.0003
Williams (2004)	MA	DEC vs. TCI	U	Satisfaction with learning experience	10	918	14	-.13	-.25, .00	2.13	.0332
M. Allen et al. (2002)	MA	DEC(F) vs. TCI	U(NS)[b]	Satisfaction with course	12	2476	12	.16	-	-	-
M. Allen et al. (2002)	MA	DEC(L) vs. TCI	U(NS)[b]	Satisfaction with course	2	421	3	.10	-	-	-

NOTES. MA = Meta-analysis and NS = National survey. DEC = Distance education course, DEC(F) = Distance education course fully interactive, DEC(L) = Distance education course limited interaction, DEC(S) = Distance education course synchronous, DEC(A) = Distance education course asynchronous, BLC = Blended (online or distance) and traditional course instruction, PSI = Personalized system of instruction courses, ATC = Audio-tutorial self-directed courses, and TCI = Traditional classroom instruction. U = University level student outcome. *k* = Number of effect sizes and CI = Confidence interval.

[a]Percent of studies including undergraduate studies.

[b]Percent of studies or sample who were undergraduate students not specified (NS).

Table S-11, continued.

Study	Type of Study	Comparison	Grade	Student Outcomes	Studies	Sample Size	*k*	Effect Size	95% CI	*Z*-test	*p*-value
M. Allen et al. (2004)	MA	DEC(S) vs. TCI	U(NS)[b]	Course grades	27	6847	27	.13	-	-	-
M. Allen et al. (2004)	MA	DEC(A) vs. TCI	U(NS)[b]	Course grades	10	1319	10	.15	-	-	-
Means et al. (2013)	MA	BLC vs. TCI	U	Student achievement	21	-	-	.31	.15, .47	3.72	.0002
Bernard et al. (2014)	MA	BLC vs. TCI	U	Academic performance	96	10800	117	.32	.28, .36	14.97	.0000
Sitzmann et al. (2006)	MA	BLC vs. TCI	U(NS)[b]	Declarative knowledge	-	6799	33	.34	.29, .39	11.33	.0000
Sitzmann et al. (2006)	MA	BLC vs. TCI	U(NS)[b]	Procedural knowledge	-	507	6	.52	.34, .70	5.78	.0000
Sitzmann et al. (2006)	MA	BLC vs. TCI	U(NS)[b]	Satisfaction with course	-	1769	11	-.15	-.26, -.05	2.50	.0124
Vo et al. (2017)	MA	BLC vs. TCI	U	Academic performance	40	7033	51	.38	.24, .53	5.13	.0000
Aiello & Wolfe (1980)	MA	PSI vs. TCI	U	Student achievement	-	-	25	.36	.24, .48	6.00	.0000
Aiello & Wolfe (1980)	MA	PSI vs. TCI	U	Student achievement	-	-	18	.26	.03, .49	2.20	.0278
Kulik et al. (1979a)	MA	PSI vs. TCI	U	Final course grade	20	-	20	.49	-	-	-
Kulik et al. (1979a)	MA	PSI vs. TCI	U	Course grades	11	-	11	.69	-	-	-
Kulik et al. (1979a)	MA	PSI vs. TCI	U	Ratings of course quality	11	-	11	.46	-	-	-

NOTES. MA = Meta-analysis and NS = National survey. DEC = Distance education course, DEC(F) = Distance education course fully interactive, DEC(L) = Distance education course limited interaction, DEC(S) = Distance education course synchronous, DEC(A) = Distance education course asynchronous, BLC = Blended (online or distance) and traditional course instruction, PSI = Personalized system of instruction courses, ATC = Audio-tutorial self-directed courses, and TCI = Traditional classroom instruction. U = University level student outcome. *k* = Number of effect sizes and CI = Confidence interval.

[a]Percent of studies including undergraduate studies.

[b]Percent of studies or sample who were undergraduate students not specified (NS).

Table S-11, continued.

Study	Type of Study	Comparison	Grade	Student Outcomes	Studies	Sample Size	*k*	Effect Size	95% CI	*Z*-test	*p*-value
Kulik et al. (1979a)	MA	PSI vs. TCI	U	Ratings of course-learning	8	-	8	.69	-	-	-
Kulik et al. (1979a)	MA	PSI vs. TCI	U	Ratings of course-enjoyment	8	-	8	.68	-	-	-
Kulik et al. (1979a)	MA	PSI vs. TCI	U	Ratings of course-work	8	-	8	.78	-	-	-
Kulik, Cohen & Ebeling (1980)	MA	PSI vs. TCI	U	Exam scores	56	-	56	.28	-	-	-
Kulik et al. (1979b)	MA	ATC vs. TCI	U	Student performance	42	-	42	.20	-	-	-
Kulik et al. (1979b)	MA	ATC vs. TCI	U	Course completion	22	-	22	.10	-	-	-
Kulik et al. (1979b)	MA	ATC vs. TCI	U	Ratings of courses-quality	6	-	6	.12	-	-	-
Aiello & Wolfe (1980)	MA	ATC vs. TCI	U	Student achievement	-	-	26	.26	.12, .40	3.68	.0002

NOTES. MA = Meta-analysis and NS = National survey. DEC = Distance education course, DEC(F) = Distance education course fully interactive, DEC(L) = Distance education course limited interaction, DEC(S) = Distance education course synchronous, DEC(A) = Distance education course asynchronous, BLC = Blended (online or distance) and traditional course instruction, PSI = Personalized system of instruction courses, ATC = Audio-tutorial self-directed courses, and TCI = Traditional classroom instruction. U = University level student outcome. *k* = Number of effect sizes and CI = Confidence interval.

[a]Percent of studies including undergraduate studies.

[b]Percent of studies or sample who were undergraduate students not specified (NS).

Table S-12

Relationships Between Technology-Assisted and E-learning Instruction and University Student Outcomes

Study	Type of Study	Comparison	Grade	Student Outcomes	Studies	Sample Size	*k*	Effect Size	95% CI	*Z*-test	*p*-value
Yaakub (1998)	MA	TAI vs. TCI	U	Student achievement	8	726	14	.45	.41, .49	22.06	.0000
Schmid et al. (2014)	MA	TAI vs. TCI	U	Student achievement	-	-	479	.25	.21, .29	22.59	.0000
Schmid et al. (2014)	MA	TAI vs. TCI	U	Student attitudes	-	-	102	.27	.17, .38	5.33	.0000
Kulik & Kulik (1991)	MA	TAI vs. TCI	U	Student achievement	-	-	97	.27	.15, .39	4.50	.0000
Kulik & Kulik (1991)	MA	TAI vs. TCI	U	Student achievement	-	-	17	.43	.23, .63	4.30	.0000
Kulik & Kulik (1991)	MA	TAI vs. TCI	U	Student achievement	-	-	35	.34	.22, .46	5.67	.0000
Michko (2008)	MA	TAI vs. NCI	U	Student achievement	45	11700	123	.43	.30, .56	6.46	.0000
Schmid et al. (2009)	MA	TAI vs. TCI	U	Student achievement	231	25497	310	.28	.25, .30	28.00	.0000
Ungerleider & Burns (2003)	MA	ICT vs. TCI	U(93)[a]	Satisfaction with method of learning	3	397	4	-.51	-.68, -.34	6.06	.0000
Ungerleider & Burns (2003)	MA	ICT vs. TCI	U(93)[a]	Course grades	8	960	12	.00	-.11, .12	.07	.9463
Zhao (2003)	MA	ICT vs. TCI	U	Foreign language proficiency	9	419	9	1.12	.61, 1.63	4.30	.0000
Castillo-Manzano et al. (2016)	MA	ICT vs. TCI	U	Exam scores	28	14629	46	.22	.13, .30	4.96	.0000

NOTES. MA = Meta-analysis and NS = National survey. TAI = Technology assisted instruction, ICT = Information and communication technology learning, ITS = Intelligent tutoring system learning, CAI = Computer-assisted instruction, CAI(SG) = Computer assisted instruction (small group), CAI(I) = Computer assisted instruction (individual), CAI(FB) = Computer assisted instruction (feedback), CAI(NF) = Computer assisted instruction (no feedback), CAI(EF) = Computer assisted instruction (elaborated feedback), CAI(LC) = Computer assisted instruction with learner control, CAI(NC) = Computer assisted instruction with no learner control, WBI = Web-based instruction, IBI = Internet-based instruction, VRI = Virtual reality instruction, TCI = Traditional classroom instruction, and NCI=No classroom instruction. G = Games, S = Simulations, and V = Virtual worlds. U = Undergraduate student outcomes and G = Graduate student outcomes. *k* = Number of effect sizes and CI = Confidence interval.

[a]Percent of sample that were undergraduate students.

[b]Percent of studies or sample who were university students not specified (NS).

Table S-12, continued.

Study	Type of Study	Comparison	Grade	Student Outcomes	Studies	Sample Size	*k*	Effect Size	95% CI	*Z*-test	*p*-value
Mothibi (2015)	MA	ICT vs. TCI	U	Student achievement	15	-	15	.71	.47, .96	5.56	.0000
Steenberger-Hu & Cooper (2014)	MA	ITS vs. TCI	U	Course grades	37	-	37	.35	.24, .46	5.83	.0000
Koufogiannakis & Wiebe (2006)	MA	CAI vs. TCI	U	Student mastery	8	796	8	-.09	-.47, .29	.47	.6383
Bayraktar (2002)	MA	CAI vs. TCI	U	Student achievement	21	-	55	.27	-	-	-
Kulik, Kulik & Cohen (1980a)	MA	CAI vs. TCI	U	Attitudes toward CBI	11	-	11	.24	-	-	-
Kulik, Kulik & Cohen (1980a)	MA	CAI vs. TCI	U	Attitudes toward course	7	-	7	.18	-	-	-
Sosa et al. (2011)	MA	CAI vs. TCI	U/G	Student performance	45	9639	45	.33	.20, .46	5.50	.0000
Aiello & Wolfe (1980)	MA	CAI vs. TCI	U	Student achievement	-	-	9	.57	.07, 1.07	2.25	.0244
Hsu (2003)	MA	CAI vs. TCI	U	Student achievement	25	3419	31	.43	.37, .49	14.05	.0000
Schenker (2007)	MA	CAI vs. TCI	U/G	Student achievement	46	9757	113	.24	.10, .38	3.46	.0010
Schenker (2007)	MA	CAI vs. TCI	U/G	Satisfaction with course	27	2585	91	.16	-.13, .45	1.10	.2810
Timmerman & Kruepke (2006)	MA	CAI vs. TCI	U/G	Student performance	118	12398	118	.24	.16,.32	5.88	.0000
Camnalbur & Erdogan (2008)	MA	CAI vs. TCI	U(NS)[b]	Student achievement	78	5096	77	1.05	.91, 1.19	14.56	.0000

NOTES. MA = Meta-analysis and NS = National survey. TAI = Technology assisted instruction, ICT = Information and communication technology learning, ITS = Intelligent tutoring system learning, CAI = Computer-assisted instruction, CAI(SG) = Computer assisted instruction (small group), CAI(I) = Computer assisted instruction (individual), CAI(FB) = Computer assisted instruction (feedback), CAI(NF) = Computer assisted instruction (no feedback), CAI(EF) = Computer assisted instruction (elaborated feedback), CAI(LC) = Computer assisted instruction with learner control, CAI(NC) = Computer assisted instruction with no learner control, WBI = Web-based instruction, IBI = Internet-based instruction, VRI = Virtual reality instruction, TCI = Traditional classroom instruction, and NCI=No classroom instruction. G = Games, S = Simulations, and V = Virtual worlds. U = Undergraduate student outcomes and G = Graduate student outcomes. *k* = Number of effect sizes and CI = Confidence interval.

[a]Percent of sample that were undergraduate students.

[b]Percent of studies or sample who were university students not specified (NS).

Table S-12, continued.

Study	Type of Study	Comparison	Grade	Student Outcomes	Studies	Sample Size	*k*	Effect Size	95% CI	*Z*-test	*p*-value
Flethcher-Flinn & Gravatt (1995)	MA	CAI vs. TCI	U	Student achievement on final exam	48	-	48	.20	.03, .37	2.31	.0209
Lou et al. (2001)	MA	CAI(SG) vs. CAI(I)	U	Student achievement	46	-	70	.20	.09, .32	3.41	.0006
Lou et al. (2001)	MA	CAI(SG) vs. CAI(I)	U	Group task performance	6	-	7	.33	.12, .55	3.09	.0020
Lou et al. (2001)	MA	CAI(SG) vs. CAI(I)	U	Attitudes toward class	15	-	22	-.04	-.23, .15	.43	.6642
Lou et al. (2001)	MA	CAI(SG) vs. CAI(I)	U	Attitudes toward CBI	13	-	16	.01	-.11, .14	.18	.8602
Lou et al. (2001)	MA	CAI(SG) vs. CAI(I)	U	Attitudes toward group work	8	-	11	.24	-.28, .75	.90	.3671
Lou et al. (2001)	MA	CAI(SG) vs. CAI(I)	U	Task completion	16	-	28	.36	.13, .58	3.06	.0022
Lou et al. (2001)	MA	CAI(SG) vs. CAI(I)	U	Task engagement	6	-	10	.05	-.21, .30	.35	.7301
Azevedo & Bernard (1995)	MA	CAI(FB) vs. CAI(NF)	U	Student achievement	11	341	17	.50	.30, .70	4.86	.0000

NOTES. MA = Meta-analysis and NS = National survey. TAI = Technology assisted instruction, ICT = Information and communication technology learning, ITS = Intelligent tutoring system learning, CAI = Computer-assisted instruction, CAI(SG) = Computer assisted instruction (small group), CAI(I) = Computer assisted instruction (individual), CAI(FB) = Computer assisted instruction (feedback), CAI(NF) = Computer assisted instruction (no feedback), CAI(EF) = Computer assisted instruction (elaborated feedback), CAI(LC) = Computer assisted instruction with learner control, CAI(NC) = Computer assisted instruction with no learner control, WBI = Web-based instruction, IBI = Internet-based instruction, VRI = Virtual reality instruction, TCI = Traditional classroom instruction, and NCI=No classroom instruction. G = Games, S = Simulations, and V = Virtual worlds. U = Undergraduate student outcomes and G = Graduate student outcomes. *k* = Number of effect sizes and CI = Confidence interval.

[a]Percent of sample that were undergraduate students.

[b]Percent of studies or sample who were university students not specified (NS).

Table S-12, continued.

Study	Type of Study	Comparison	Grade	Student Outcomes	Studies	Sample Size	*k*	Effect Size	95% CI	*Z*-test	*p*-value
Van der Kleij et al. (2015)	MA	CAI(EF) vs. CAI(NF)	U(80)[a]	Learning outcomes	53	-	53	.29	.34, .64	6.20	.0000
Karich et al. (2014)	MA	CAI(LC) vs. CAI(NC)	U	Student achievement	9	-	14	.07	-.13, .27	.69	.4902
Parsons (1991)	MA	CAI(LC) vs. CAI(NC)	U	Student achievement	24	2420	50	-.03	-1.39, 1.32	.05	.9601
Sitzmann et al. (2006)	MA	WBI vs. TCI	U(NS)[b]	Declarative knowledge	-	10910	71	.15	.11, .19	7.50	.0000
Sitzmann et al. (2006)	MA	WBI vs. TCI	U(NS)[b]	Procedural knowledge	-	944	12	-.07	-.20, .06	1.00	.3173
Sitzmann et al. (2006)	MA	WBI vs. TCI	U(NS)[b]	Satisfaction with course	-	2580	22	.00	-.09, .09	0.00	.9999
Cook et al. (2010)	MA	IBI vs. NCI	U/G	Learning outcomes (knowledge, skills, behavior)	24	-	46	.42	.16, .63	2.53	.0057
Cook et al. (2010)	MA	IBI vs. NCI	U/G	Learning outcomes (knowledge, skills, behavior)	5	-	5	.93	-.09, 1.87	1.45	.0735
Cook et al. (2010)	MA	IBI vs. NCI	U/G	Satisfaction with course	-	-	23	.47	-.04, 1.01	1.43	.0767
Merchant et al. (2014)	MA	VRI(G) vs. TCI	U(57)[a]	Learning outcomes (mix of standardized and instructor-made tests)	13	3081	13	.51	.25, .77	3.92	.0001

NOTES. MA = Meta-analysis and NS = National survey. TAI = Technology assisted instruction, ICT = Information and communication technology learning, ITS = Intelligent tutoring system learning, CAI = Computer-assisted instruction, CAI(SG) = Computer assisted instruction (small group), CAI(I) = Computer assisted instruction (individual), CAI(FB) = Computer assisted instruction (feedback), CAI(NF) = Computer assisted instruction (no feedback), CAI(EF) = Computer assisted instruction (elaborated feedback), CAI(LC) = Computer assisted instruction with learner control, CAI(NC) = Computer assisted instruction with no learner control, WBI = Web-based instruction, IBI = Internet-based instruction, VRI = Virtual reality instruction, TCI = Traditional classroom instruction, and NCI=No classroom instruction. G = Games, S = Simulations, and V = Virtual worlds. U = Undergraduate student outcomes and G = Graduate student outcomes. *k* = Number of effect sizes and CI = Confidence interval.

[a]Percent of sample that were undergraduate students.

[b]Percent of studies or sample who were university students not specified (NS).

Table S-12, continued.

Study	Type of Study	Comparison	Grade	Student Outcomes	Studies	Sample Size	*k*	Effect Size	95% CI	*Z*-test	*p*-value
Merchant et al. (2014)	MA	VRI(S) vs. TCI	U(57)[a]	Learning outcomes (mix of standardized and instructor-made tests)	29	2553	29	.41	.18, .64	3.73	.0002
Merchant et al. (2014)	MA	VRI(V) vs. TCI	U(57)[a]	Learning outcomes (mix of standardized and instructor-made tests)	25	2798	25	.41	.23, .59	4.56	.0000

NOTES. MA = Meta-analysis and NS = National survey. TAI = Technology assisted instruction, ICT = Information and communication technology learning, ITS = Intelligent tutoring system learning, CAI = Computer-assisted instruction, CAI(SG) = Computer assisted instruction (small group), CAI(I) = Computer assisted instruction (individual), CAI(FB) = Computer assisted instruction (feedback), CAI(NF) = Computer assisted instruction (no feedback), CAI(EF) = Computer assisted instruction (elaborated feedback), CAI(LC) = Computer assisted instruction with learner control, CAI(NC) = Computer assisted instruction with no learner control, WBI = Web-based instruction, IBI = Internet-based instruction, VRI = Virtual reality instruction, TCI = Traditional classroom instruction, and NCI=No classroom instruction. G = Games, S = Simulations, and V = Virtual worlds. U = Undergraduate student outcomes and G = Graduate student outcomes. *k* = Number of effect sizes and CI = Confidence interval.

[a]Percent of sample that were undergraduate students.

[b]Percent of studies or sample who were university students not specified (NS).

Table S-13

Relationships Between Course-Based Learning Methods and University Student Outcomes

Study	Type of Study	Comparison	Grade	Student Outcomes	Studies	Sample Size	*k*	Effect Size	95% CI	*Z*-test	*p*-value
Leary (2012)	MA	PBL vs. TCI	U/G	Self-directed learning	38	13899	75	.45	.33, .58	7.11	.0000
Leary (2012)	MA	PBL vs. TCI	U/G	Personal autonomy	31	11032	48	.51	.35, .66	6.40	.0000
Leary (2012)	MA	PBL vs. TCI	U/G	Self-management of learning	6	1029	6	.35	-.02, .70	1.88	.0601
Leary (2012)	MA	PBL vs. TCI	U/G	Independent pursuit of learning	3	443	3	.66	.29, 1.03	3.49	.0005
Leary (2012)	MA	PBL vs. TCI	U/G	Learner self-directed learning	15	1395	18	.28	-.02, .58	1.81	.0703
Leary et al. (2013) (E)	MA	PBL vs. TCI	U/G	Performance	-	17187	132	.26	.16, .35	5.66	.0000
Leary et al. (2013)(N)	MA	PBL vs. TCI	U/G	Performance	-	1792	14	.25	.13, .36	4.22	.0000
Dochy et al. (2003); Gijbels et al. (2005)	MA	PBL vs. TCI	G	Knowledge of concepts	21	5155	21	.07	-.80, .93	.15	.8774
Dochy et al (2003); Gijbels et al. (2005)	MA	PBL vs. TCI	G	Knowledge of principles	15	5091	15	.80	.01, 1.58	1.99	.0466
Dochy et al (2003); Gijbels et al. (2005)	MA	PBL vs. TCI	G	Knowledge application	13	1474	13	.34	-.32, 1.00	1.00	.3173

NOTES. MA = Meta-analysis and NS = National survey. E = Expert tutor and N = Novice tutor. PBL = Problem-based learning, PBL(O) = Problem-based learning online, GD = Guided design, ASL = Active student learning, SDL = Student self-directed learning, DL(U) = Discovery learning unassisted, DL(E) = Discovery learning enhanced, IBL = Inquiry-based learning, PJL = Project-based learning, EBL = Explanation-based learning, VBI = Visually-based instruction, CTI = Critical thinking instruction, NTP = Note taking practices, GNT = Guided note taking, NTA = Note taking aides, EI = Explicit instruction, TCI = Traditional class instruction, and NI = No instruction. U = Undergraduate students and G = Graduate students. *k* = Number of effect sizes and CI = Confidence interval.

[a]Percent of studies or sample who were university students not specified (NS).

Table S-13, continued.

Study	Type of Study	Comparison	Grade	Student Outcomes	Studies	Sample Size	*k*	Effect Size	95% CI	*Z*-test	*p*-value
Ustun (2012)	MA	PBL vs. TCI	U	Science composite measure	45	-	70	.56	.43, .68	8.86	.0000
Schmidt et al. (2009)	MA	PBL vs. TCI	G	Medical knowledge	7	26574	29	.07	-	-	-
Schmidt et al. (2009)	MA	PBL vs. TCI	G	Diagnostic reasoning	4	1157	5	.11	-	-	-
Schmidt et al. (2009)	MA	PBL vs. TCI	G	Communication skills	4	1574	5	.69	-	-	-
Schmidt et al. (2009)	MA	PBL vs. TCI	G	Performance	3	2714	7	.83	-	-	-
Schmidt et al. (2009)	MA	PBL vs. TCI	G	Judgements of medical education	3	1130	5	.66	-	-	-
Vernon & Blake (1993)	MA	PBL vs. TCI	G	Student attitudes about medical education	5	679	8	.55	.40, .70	7.19	.0000
Vernon & Blake (1993)	MA	PBL vs. TCI	G	Student achievement	5	2299	23	-.18	-.26, -.10	4.41	.0000
Vernon & Blake (1993)	MA	PBL vs. TCI	G	Student achievement	5	681	5	-.09	-.24, .06	1.18	.2380
Vernon & Blake (1993)	MA	PBL vs. TCI	G	Students' clinical performance	8	997	16	.28	.16, .40	4.57	.0000
Jurewitsch (2012)	MA	PBL(O) vs. PBL	U	Student achievement	5	518	5	.57	-.14, 1.28	1.56	.1188
Dunst et al. (2010)	MA	GD vs. TCI	U	Student performance	10	1173	13	.48	.36, .59	8.23	.0000

NOTES. MA = Meta-analysis and NS = National survey. E = Expert tutor and N = Novice tutor. PBL = Problem-based learning, PBL(O) = Problem-based learning online, GD = Guided design, ASL = Active student learning, SDL = Student self-directed learning, DL(U) = Discovery learning unassisted, DL(E) = Discovery learning enhanced, IBL = Inquiry-based learning, PJL = Project-based learning, EBL = Explanation-based learning, VBI = Visually-based instruction, CTI = Critical thinking instruction, NTP = Note taking practices, GNT = Guided note taking, NTA = Note taking aides, EI = Explicit instruction, TCI = Traditional class instruction, and NI = No instruction. U = Undergraduate students and G = Graduate students. *k* = Number of effect sizes and CI = Confidence interval.

[a]Percent of studies or sample who were university students not specified (NS).

Table S-13, continued.

Study	Type of Study	Comparison	Grade	Student Outcomes	Studies	Sample Size	*k*	Effect Size	95% CI	*Z*-test	*p*-value
Dunst et al. (2010)	MA	GD vs. TCI	U	Beliefs appraisals	6	478	6	.52	.34, .69	5.86	.0000
Freeman et al (2014)	MA	ASL vs. TCI	U	Course achievement	158	-	158	.47	.38, .56	9.78	.0000
Murad et al. (2010)	MA	SDL vs. TCI	G	Medical knowledge	6	-	6	.13	-.23, .47	-	-
Benz (2010)	MA	SDL vs TCI	U	Academic achievement	-	830	16	.33	.02, .64	2.09	.0366
Alfieri et al. (2011)	MA	DL(E) vs. EI	U	Course grades	17	1190	20	.34	-.02, .69	1.83	.0665
Alfieri et al. (2011)	MA	DL(U) vs. EI	U	Course grades	35	1914	43	-.16	-.38, .06	1.43	.1519
Sweitzer & Anderson (1983)	MA	IBL vs. TCI	U	Composite measure	-	-	122	.78	.62, .94	9.57	.0000
Yeany & Padilla (1986)	MA	IBL vs. TCI	U(NS)[a]	Teaching practices	-	-	10	.72	-	-	-
Ayaz & Soylemez (2015)	MA	PJL vs. TCI	U	Academic achievement	9	-	9	.68	.22, 1.14	2.90	.0037
Wittwer & Renkl (2010)	MA	EBL vs. TCI	U (NS)[a]	Student transfer	20	-	40	.10	-.22, .42	.61	.5419
Wittwer & Renkl (2010)	MA	EBL vs. TCI	U (NS)[a]	Student knowledge	6	-	17	.35	-.43, 1.13	.89	.3816
Cohen et al. (1981)	MA	VBI vs. TCI	U	Final course grade	65	-	65	.15	-	-	-
Cohen et al. (1981)	MA	VBI vs. TCI	U	Student recall	6	-	6	.20	-	-	-
Cohen et al. (1981)	MA	VBI vs. TCI	U	Attitude toward subject matter	6	-	6	-.18	-	-	-

NOTES. MA = Meta-analysis and NS = National survey. E = Expert tutor and N = Novice tutor. PBL = Problem-based learning, PBL(O) = Problem-based learning online, GD = Guided design, ASL = Active student learning, SDL = Student self-directed learning, DL(U) = Discovery learning unassisted, DL(E) = Discovery learning enhanced, IBL = Inquiry-based learning, PJL = Project-based learning, EBL = Explanation-based learning, VBI = Visually-based instruction, CTI = Critical thinking instruction, NTP = Note taking practices, GNT = Guided note taking, NTA = Note taking aides, EI = Explicit instruction, TCI = Traditional class instruction, and NI = No instruction. U = Undergraduate students and G = Graduate students. *k* = Number of effect sizes and CI = Confidence interval.

[a]Percent of studies or sample who were university students not specified (NS).

Table S-13, continued.

Study	Type of Study	Comparison	Grade	Student Outcomes	Studies	Sample Size	*k*	Effect Size	95% CI	*Z*-test	*p*-value
Cohen et al. (1981)	MA	VBI vs. TCI	U	Attitude toward instruction	16	-	16	-.06	-	-	-
Henk & Stahl (1985)	MA	NTP vs. LOP	U	Student recall	14	-	25	.34	-	-	-
Kobayaski (2005)	MA	NTP vs. NNT	U	Student recall	-	-	97	.14	.05, .23	3.04	.0024
Larwin & Larwin (2013)	MA	GNT vs. TCI	U	Academic performance	-	-	12	.67	-	-	-
Larwin et al. (2013)	MA	NTA vs. NNA	U/G	Course grades	15	1348	35	.34	.15, .53	3.50	.0005
Abrami et al. (2015)	MA	CTI vs. TCI	U	Critical thinking skills	-	-	126	.26	.19, .33	6.50	.0000

NOTES. MA = Meta-analysis and NS = National survey. E = Expert tutor and N = Novice tutor. PBL = Problem-based learning, PBL(O) = Problem-based learning online, GD = Guided design, ASL = Active student learning, SDL = Student self-directed learning, DL(U) = Discovery learning unassisted, DL(E) = Discovery learning enhanced, IBL = Inquiry-based learning, PJL = Project-based learning, EBL = Explanation-based learning, VBI = Visually-based instruction, CTI = Critical thinking instruction, NTP = Note taking practices, GNT = Guided note taking, NTA = Note taking aides, EI = Explicit instruction, TCI = Traditional class instruction, and NI = No instruction. U = Undergraduate students and G = Graduate students. *k* = Number of effect sizes and CI = Confidence interval.

[a]Percent of studies or sample who were university students not specified (NS).

Table S-14
Relationships Between Cooperative Learning Practices and University Student Outcomes

Study	Type of Study	Comparison	Grade	Student Outcomes	Studies	Sample Size	*k*	Effect Size	95% CI	*Z*-test	*p*-value
Springer et al. (1999)	MA	SGL vs. TCI	U	Student achievement	31	2559	37	.57	-	-	-
Springer et al. (1999)	MA	SGL vs. TCI	U	Attitudes toward course	7	393	7	.56	-	-	-
Kalaian & Kasim (2014)	MA	SGL vs. TCI	U	Student achievement	9	926	10	.47	.26, .69	4.33	.0000
Huddy (2012)	MA	SGL vs. TCI	U	Student achievement	8	801	8	.53	.38, .69	6.76	.0000
Huddy (2012)	MA	SGL vs. TCI	U	Course grades	8	879	8	.45	.31, .60	6.21	.0000
Huddy (2012)	MA	SGL vs. TCI	U	Performance	2	135	2	.53	.15, .92	2.71	.0067
Huddy (2012)	MA	SGL vs. TCI	U	Listening skills	2	130	2	.39	.05, .74	2.24	.0251
Huddy (2012)	MA	SGL vs. TCI	U	Speaking skills	2	130	2	.21	-.13, .55	1.20	.2301
Capar & Tarim (2015)	MA	SGL vs. TCI	U	Math achievement	4	-	5	1.33	.60, 2.06	3.57	.0004
Lou et al. (1996)	MA	SGL vs. TCI	U	Student achievement	-	-	7	.19	-.03, .42	1.62	.1052
Bowen (2000)	MA	SGL vs. TCI	U(72)[a]	Student achievement	11	1537	30	.37	.23, .51	5.28	.0000
Liu & Beaujean (2017)	MA	SGI vs. TCI	U	Student performance	10	-	10	.38	-.09, .85	1.58	.1141
Pai et al. (2015)	MA	SGI vs. INI	U(81)[a]	Transfer performance	24	3106	38	.30	.16, .44	4.29	.0000
Johnson et al. (1981)	MA	SGI vs. INI	U(NS)[b]	Student achievement	-	-	104	.78	-	-	-

NOTES. MA = Met-analysis and NS = National Survey. SGL = Small group learning, SGI = Small group instruction, SGI(C)= Small group instruction (computer assisted), INI(C) = Individual instruction (computer assisted), PT = Peer tutoring, PI = Peer instruction, FI = Faculty instruction, PI+TCI = Peer instruction as part of traditional classroom instruction, TCI = Traditional class instruction, and NPT = No peer tutoring. U = Undergraduate students. *k* = Number of effect sizes and CI = Confidence interval.

[a]Percent of sample that were university students.

[b]Percent of studies or participants who were undergraduate students not specified (NS).

Table S-14, continued.

Study	Type of Study	Comparison	Grade	Student Outcomes	Studies	Sample Size	*k*	Effect Size	95% CI	*Z*-test	*p*-value
Lou et al. (2001)	MA	SGI(C) vs. INI(C)	U	Individual achievement	46	-	70	.20	.09,.32	3.41	.0006
Lou et al. (2001)	MA	SGI(C) vs. INI(C)	U	Group task performance	6	-	7	.33	.12, .55	3.09	.0020
Lou et al. (2001)	MA	SGI(C) vs. INI(C)	U	Attitudes toward class	15	-	22	-.04	-.23, .15	.43	.6642
Lou et al. (2001)	MA	SGI(C) vs. INI(C)	U	Attitudes toward CBI	13	-	16	.01	-.11, .14	.18	.8602
Lou et al. (2001)	MA	SGI(C) vs. INI(C)	U	Attitude toward group work	8	-	11	.24	-.28, .75	.90	.3671
Lou et al. (2001)	MA	SGI(C) vs. INI(C)	U	Performance	16	-	28	.36	.13, .58	3.06	.0022
Lou et al. (2001)	MA	SGI(C) vs. INI(C)	U	Task engagement	6	-	10	.05	-.21, .30	.35	.7301
Leung (2015)	MA	PT vs. NPT	U	Student achievement	9	-	9	.38	.16, .60	3.39	.0007
Alegre-Ansuategui et al. (2018)	MA	PT vs. NPT	U	Math achievement	4	1397	4	.06	-.11, .22	.74	.4593
Rees et al. (2016)	MA	PI vs. FI	U	Medical knowledge	10	1300	10	.07	-.07, .21	.99	.3210
Rees et al. (2016)	MA	PI vs. FI	U	Performance	10	1300	10	.11	-.07, 1.29	1.18	.2390
Balta et al. (2017)	MA	PI+TCI vs. TCI	U	Student achievement	16	2050	16	.96	.59, 1.33	5.07	.0000

NOTES. MA = Met-analysis and NS = National Survey. SGL = Small group learning, SGI = Small group instruction, SGI(C)= Small group instruction (computer assisted), INI(C) = Individual instruction (computer assisted), PT = Peer tutoring, PI = Peer instruction, FI = Faculty instruction, PI+TCI = Peer instruction as part of traditional classroom instruction, TCI = Traditional class instruction, and NPT = No peer tutoring. U = Undergraduate students. *k* = Number of effect sizes and CI = Confidence interval.

[a]Percent of sample that were university students.

[b]Percent of studies or participants who were undergraduate students not specified (NS).

Table S-15

Relationships Between Faculty Instructional Practices and Faculty Performance

Study	Type of Study	Comparison	Grade	Faculty Performance	Studies	Sample Size	*k*	Effect Size	95% CI	*Z*-test	*p*-value
Penny & Coe (2004)	MA	CF vs. NF	F	Instructor performance	11	331	11	.69	.43, .95	5.20	.0000
Yeany & Padilla (1986)	MA	FC vs. NF	F	Instructional practices	-	-	14	2.30	-	-	-
Fukkink et al. (2011)[a]	MA	IVF vs. NF(58)[a]	F	Interactional skills	33	1058	217	.40	.26, .54	5.71	.0000
Menges & Brinko (1986)	MA	SFB vs. NF	F	Instructor performance	27	-	31	.44	.21, .66	3.83	.0001
Cohen (1980)	MA	SFB vs. NF	F	Instructor effectiveness	17	-	22	.38	-	-	-

NOTES. All outcomes were faculty or course instructor measures. MA = Meta-analysis. CF = Consultative feedback on student ratings of instructor practices, FC = Faculty coaching of student performance, SFB = Student feedback on instructor practices, IVF = Instructor video feedback on faculty performance, NF = No feedback or coaching. F = Faculty or course instructor outcomes. *k* = Number of effect sizes, and CI = Confidence interval.

[a]Fifty-eight percent of participants were undergraduate students.

Table S-16

Relationships Between Faculty Instructional Practices and University Student Outcomes

Study	Type of Study	Comparison	Grade	Student Outcomes	Studies	Sample Size	*k*	Effect Size	95% CI	*Z*-test	*p*-value
Dunst et al. (2010)	MA	FC vs. TCI	U	Student performance	3	83	4	1.39	.93, 1.85	5.96	.0000
Dunst et al. (2010)	MA	FC vs. TCI	U	Student beliefs	2	109	2	.38	-.01, .76	1.93	.0536
Aiello & Wolfe (1980)	MA	ISI vs. TCI	U	Student achievement	-	-	22	.70	.31, 1.09	3.53	.0004
Dunst et al. (2010)	MA	JIT vs. TCI	U	Student performance	5	545	5	.58	.40, .77	6.30	.0000
Eby et al. (2008)	MA	FM vs. NM	U/G	Academic performance	8	1444	8	.39	.26, .54	4.87	.0000
Eby et al. (2008)	MA	FM vs. NM	U/G	Academic retention	5	1088	5	.22	04, .39	2.44	.0073
Eby et al. (2008)	MA	FM vs. NM	U/G	Attitudes toward academics	3	1038	3	.77	.45, 1.12	4.28	.0000
Eby et al. (2008)	MA	FM vs. NM	U/G	Academic motivation	9	1444	9	.28	.16, .41	4.00	.0001
Sneyers & Witte (2018)	MA	FM vs. NM	U	First year retention	7	19271	7	.15	.06, .23	3.75	.0091
Sneyers & Witte (2018)	MA	FM vs. NM	U	Graduation rate	2	1720	2	.10	.01, .19	2.17	.0150
Bangert-Drowns et al. (1991)	MA	FFB vs. NFB	U	Performance	28	2460	42	.28	.14, .42	4.00	.0000
Kulik & Kulik (1988)	MA	FFB vs. NFB	U	Performance	10	-	18	.35	-.06, .76	1.67	.0949
Cohen (1980)	MA	SFB vs. NSF	U	Student judgments of personal learning	3	-	4	.30	-	-	-

NOTES. MA = Meta-analysis. FC = Faculty coaching, ISI = Individualized student instruction, JIT = Just in time instruction, FM = Faculty mentoring, FFB = Faculty feedback on student performance, SFB = Student feedback on instructor practices, NM = No faculty mentoring, NFB = No faculty feedback, NSF = No student feedback, and TCI = Traditional classroom instruction. U = Undergraduate students and G = Graduate students. *k* = Number of effect sizes and CI = Confidence interval.

Table S-16, continued.

Study	Type of Study	Comparison	Grade	Student Outcomes	Studies	Sample Size	*k*	Effect Size	95% CI	*Z*-test	*p*-value
Cohen (1980)	MA	SFB vs. NSF	U	Student attitude toward subject matter	3	-	4	.42	-	-	-
Cohen (1980)	MA	SFB vs. NSF	U	Student achievement	2	-	4	.19	-	-	-
Menges & Brinko (1986)	MA	SFB vs. NSF	U	Student achievement	3	-	4	.25	-.35, .85	.82	.4122
Menges & Brinko (1986)	MA	SFB vs. NSF	U	Attitude toward subject matter	3	-	5	.40	.18, .62	3.57	.0004

NOTES. MA = Meta-analysis. FC = Faculty coaching, ISI = Individualized student instruction, JIT = Just in time instruction, FM = Faculty mentoring, FFB = Faculty feedback on student performance, SFB = Student feedback on instructor practices, NM = No faculty mentoring, NFB = No faculty feedback, NSF = No student feedback, and TCI = Traditional classroom instruction. U = Undergraduate students and G = Graduate students. *k* = Number of effect sizes and CI = Confidence interval.

Table S-17

Relationships Between Teaching Method Instruction and Teaching Quality

Study	Type of Study	Comparison	Grade	Teaching Quality	Studies	Sample Size	*k*	Effect Size	95% CI	*Z*-test	*p*-value
Gliessman et al. (1988)	MA	TPI vs. NTI	U/G	Use of questioning skills	9	-	9	.79	.58, 1.01	7.04	.0000
Metcalf (1995)	MA	MCT vs. NTI	U	Teaching practices	15	1043	18	.68	-	-	-
Butcher (1981)	MA	MCT vs. NTI	U	Teaching practices	47		47	.55			
Baker & Daniels (1989)	MA	MCC vs. TCI	U	Counseling skills	32	-	32	1.18	.85, 1.51	6.94	.0000
Baker & Daniels (1989)	MA	MCC vs. TCI	G	Counseling skills	20	-	20	.66	.44, .88	6.00	.0000
Metcalf (1995)	MA	MNC vs. NTI	U	Teaching practices	3	79	4	.70	-	-	-
Metcalf (1995)	MA	SBI vs. NTI	U	Teaching practices	1	-	2	.52	-	-	-
Cook et al. (2013)	MA	SBI vs. NTI	U(74)[a]	Clinical skills	100	4198	100	.20	-.65, .97	.51	.6101
Kim et al. (2016)	MA	SBI vs. NTI	U(86)[a]	Clinical skills	40	2924	40	.70	.58, .83	11.67	.0000
McGaghie et al. (2011)	MA	SBI(DP) vs. TCI	G	Clinical skills	10	-	10	1.67	.90, 2.58	-	-
Metcalf (1995)	MA	PTO vs. NTI	U	Teaching practices	2	108	4	.78	.12, 1.44	2.68	.0074
Metcalf (1995)	MA	MOT vs. NTI	U	Teaching practices	4	111	6	.59	-	-	-

NOTES. MA = Meta-analysis. TPI = Teaching practices instruction, MCT = Microteaching, MCC = Microcounseling, MNC = Minicourses, SBI = Simulation-based instruction, SBI(DP) = Simulation-based instruction with deliberate practice, PTO = Peer-facilitated teaching opportunity, MOT = Video or in-vivo observations of teaching methods, CTI = Critical thinking instruction, TCI = Traditional classroom or counseling instruction, and NTI = No teaching instruction. U = Undergraduate students and G = Graduate students. *k* = Number of effect sizes and CI = Confidence interval.

[a]Percent of participants who were university students.

Table S-17, continued.

Study	Type of Study	Comparison	Grade	Student Outcomes	Studies	Sample Size	*k*	Effect Size	95% CI	*Z*-test	*p*-value
Liu & Chang (2017)	MA	CTI vs. TCI	U	Use of creative thinking strategies	11	745	11	.95	.62, 1.28	5.62	.0000
Gliessman et al. (1988)	MA	CTI vs. NCI	U/G	Use of questioning skills	17	-	17	.85	.64, 1.05	8.33	.0000

NOTES. MA = Meta-analysis. TPI = Teaching practices instruction, MCT = Microteaching, MCC = Microcounseling, MNC = Minicourses, SBI = Simulation-based instruction, SBI(DP) = Simulation-based instruction with deliberate practice, PTO = Peer-facilitated teaching opportunity, MOT = Video or in-vivo observations of teaching methods, CTI = Critical thinking instruction, TCI = Traditional classroom or counseling instruction, and NTI = No teaching instruction. U = Undergraduate students and G = Graduate students. *k* = Number of effect sizes and CI = Confidence interval.

[a]Percent of participants who were university students.

Table S-18

Relationships Between Teaching Method Instruction and University Student Outcome

Study	Type of Study	Comparison	Grade	Student Outcomes	Studies	Sample Size	*k*	Effect Size	95% CI	*Z*-test	*p*-value
Metcalf (1995)	MA	MCT vs. NTI	U	Teacher affect	2	66	2	.50	-	-	-
Metcalf (1995)	MA	MCT vs. NTI	U	Teacher knowledge	4	200	4	.09	-	-	-
Metcalf (1995)	MA	PTO vs. NTI	U	Teacher affect	2	-	2	.47	-	-	-
Metcalf (1995)	MA	PTO vs. NTI	U	Teacher knowledge	3	-	3	.32	-	-	-
Metcalf (1995)	MA	SBI vs. NTI	U	Teacher affect	3	-	5	.38	-	-	-
Metcalf (1995)	MA	SBI vs. NTI	U	Teacher knowledge	1	72	2	.79	-	-	-
Cook et al. (2013)	MA	SBI vs. NTI	U(74)[a]	Satisfaction with teaching method	56	3042	56	.51	-.33, 1.35	1.19	.2340
Cook et al. (2013)	MA	SBI vs. NTI	U(74)[a]	Clinical knowledge	34	2687	34	.14	-.13, .41	1.02	.3077
Metcalf (1995)	MA	MOT vs. NTI	U	Teacher affect	2	91	2	.23	-	-	-
Metcalf (1995)	MA	MOT vs. NTI	U	Teacher knowledge	3	143	4	.56	-	-	-
Niu et al. (2013)	MA	CTI vs. NCI	U	Critical thinking skills	31	-	40	.19	.09, .30	3.55	.0004

NOTES. MA = Meta-analysis. MCT = Microteaching, MCC = Microcounseling, PTO = Peer-facilitated teaching opportunity, SBI = Simulation-based instruction, MOT = Video or in-vivo modeling of teaching methods, CTI = Critical thinking instruction, TCI = Traditional classroom or counseling instruction, and NTI = No teaching instruction. U = Undergraduate students. *k*= Number of effect sizes and CI = Confidence interval.

[a]Percent of participants who were university students.

Table S-19

Relationships Between Types of Field Experiences and Teaching Quality

Study	Type of Study	Comparison[a]	Grade	Teaching Quality	Studies	Sample Size	*k*	Effect Size	95% CI	*Z*-test	*p*-value
Boe et al. (2007) (GE)	NS	EST vs. NST	U	Instructional planning	1	8861	1	2.31	-	-	-
Boe et al. (2007) (GE)	NS	EST vs. NST	U	Instructional methods	1	8861	1	1.79	-	-	-
Boe et al. (2007) (GE)	NS	EST vs. NST	U	Classroom management	1	8861	1	1.32	-	-	-
Boe et al. (2007) (GE)	NS	EST vs. NST	U	Subject matter teaching	1	8861	1	.98	-	-	-
Boe et al. (2007) (GE)	NS	LST vs. NST	U	Instructional planning	1	1456	1	.86	-	-	-
Boe et al. (2007) (GE)	NS	LST vs. NST	U	Instructional methods	1	1456	1	.66	-	-	-
Boe et al. (2007) (GE)	NS	LST vs. NST	U	Classroom management	1	1456	1	.69	-	-	-
Boe et al. (2007) (GE)	NS	LST vs. NST	U	Subject matter teaching	1	1456	1	.61	-	-	-
Boe et al. (2007) (SE)	NS	EST vs. NST	U	Instructional planning	1	1068	1	2.15	-	-	-
Boe et al. (2007) (SE)	NS	EST vs. NST	U	Instructional methods	1	1068	1	2.06	-	-	-
Boe et al. (2007) (SE)	NS	EST vs. NST	U	Classroom management	1	1068	1	.59	-	-	-
Boe et al. (2007) (SE)	NS	EST vs. NST	U	Subject matter teaching	1	1068	1	1.23	-	-	-
Boe et al. (2007) (SE)	NS	LST vs. NST	U	Instructional planning	1	207	1	1.03	-	-	-

NOTES. MA = Meta-analysis and NS = National Survey. GE = General education students, SE = Special education students, GEC = General education courses, MC = Methods courses, and SM = Science method courses. EST = Extensive student teaching, LST = Limited student teaching, FE = Course field experience, NST = No student teaching experience, and NFE = No course field experience. *k* = Number of effect sizes and CI = Confidence interval.

[a]EST = Ten or more weeks of student (practice) teaching, LST = Five to nine weeks of student (practice) teaching, and NST = Little or no student (practice) teaching.

Table S-19, continued.

Study	Type of Study	Comparison[a]	Grade	Teaching Quality	Studies	Sample Size	*k*	Effect Size	95% CI	*Z*-test	*p*-value
Boe et al. (2007) (SE)	NS	LST vs. NST	U	Instructional methods	1	207	1	1.01	-	-	-
Boe et al. (2007) (SE)	NS	LST vs. NST	U	Classroom management	1	207	1	.33	-	-	-
Boe et al. (2007) (SE)	NS	LST vs. NST	U	Subject matter teaching	1	207	1	.81	-	-	-
Malone (1984) (GE)	MA	CFE vs. NFE	U	Teaching practices	-	-	4	.36	-.06, .78	1.67	.0949
Malone (1984) (MC)	MA	CFE vs. NFE	U	Teaching practices	-	-	6	.06	-.27, .39	.36	.7188
Malone (1984) (SM)	MA	CFE vs. NFE	U	Teaching practices	-	-	1	.97	-	-	-

NOTES. MA = Meta-analysis and NS = National Survey. GE = General education students, SE = Special education students, GEC = General education courses, MC = Methods courses, and SM = Science method courses. EST = Extensive student teaching, LST = Limited student teaching, CFE = Course field experience, NST = No student teaching experience, and NFE = No course field experience. *k* = Number of effect sizes and CI = Confidence interval.

[a]EST = Ten or more weeks of student (practice) teaching, LST = Five to nine weeks of student (practice) teaching, and NST = Little or no student (practice) teaching.

Table S-20

Relationships Between Types of Field Experiences and University Student and Beginning Teacher Outcomes

Study	Type of Study	Comparison	Grade	Outcomes	Studies	Sample Size	*k*	Effect Size	95% CI	*Z*-test	*p*-value
Malone (1984) (GE)	MA	CFE vs. NFE	U	General attitudes	-	-	6	.32	-.21, .85	1.19	.2340
Malone (1984) (MC)	MA	CFE vs. NFE	U	General attitudes	-	-	24	.12	-.04, .28	1.51	.1310
Malone (1984) (SC)	MA	CFE vs. NFE	U	General attitudes	-	-	5	-.06	-.21, .09	.79	.4295
Malone (1984) (GE)	MA	CFE vs. NFE	U	Student achievement	-	-	3	.53	.48, .58	22.95	.0000
Malone (1984) (MC)	MA	CFE vs. NFE	U	Student achievement	-	-	9	-.02	-.29, .25	.14	.8887
Malone (1984) (SC)	MA	CFE vs. NFE	U	Student achievement	-	-	5	.12	-.01, .25	1.79	.0734
Malone (1984) (GE)	MA	CFE vs. NFE	ST/FT	Composite measure	-	-	6	.10	-.05, .25	1.29	.2077
Malone (1984) (MC)	MA	CFE vs. NFE	ST/FT	Composite measure	-	-	13	.20	.04, .36	2.40	.0164
Malone (1984) (SC)	MA	CFE vs. NFE	ST/FT	Composite measure	-	-	2	-.16	-.51, .19	-.91	.3628
Yang (2017)	MA	SL vs. NSL	U(74)[a]	Attitudes toward self	36	-	36	.28	.18, .38	5.49	.0000
Yang (2017)	MA	SL vs. NSL	U(74)[a]	Attitudes toward school and learning	12	-	12	.28	.12, .43	3.68	.0002
Yang (2017)	MA	SL vs. NSL	U(74)[a]	Civic engagement	28	-	28	.27	.16, .38	4.82	.0000
Yang (2017)	MA	SL vs. NSL	U(74)[a]	Social skills	28	-	28	.31	.18, .38	8.61	.0000
Yang (2017)	MA	SL vs. NSL	U(74)[a]	Academic achievement	17	-	17	.43	.29, .58	5.66	.0000
Novak et al. (2007)	MA	SL vs NSL	U	Knowledge	9	1610	9	.42	-	-	-

NOTES. MA = Meta-analysis. GE = General education courses, MC = Methods courses, and SC = Science methods courses. CFE = Course field experience, SL = Service learning, NFE = No field experience, and NSL = No service learning. U = University student outcomes and ST/FT = Outcomes measured during student teaching or during initial year of teaching. *k* = Number of effect sizes and CI = Confidence interval.

[a]Percent of sample who were university students.

Table S-21

Relationships Between Clinical Supervision and Related Practices and University Student Outcomes

Study	Type of Study	Comparison	Grade	Outcomes	Studies	Sample Size	*k*	Effect Size	95% CI	*Z*-test	*p*-value
Hatala et al. (2013)	MA	FB vs. NFB	U/G	Knowledge and skills	17	653	17	.74	.38, 1.09	4.09	.0000
Kluger & DeNisi (1996)	MA	FB vs. NFB	U/CE	Clinical performance	131	12652	607	.41	-.18, 1.00	1.37	.1707
Whittaker (2004)	MA	CS vs. NCS	G	Self-efficacy	4	95	4	.66	.23, 1.08	2.87	.0041
Whittaker (2004)	MA	CS vs. NCS	G	Anxiety	8	293	8	.45	.19, .72	3.49	.0005

NOTES. MA = Meta-analysis. U = University student outcome, G = Graduate students and CE = Career employees. FB = Supervisor feedback on student performance, CS = Clinical supervision, NFB = No feedback, and NCS = No clinical supervision. U = Undergraduate students, G = graduate students, and CE = Career employees. *k*= Number of effect sizes and CI = Confidence interval.

Table S-22

Relationships Between School-Based Induction and Mentoring and University Student and Teacher Outcomes

Study	Type of Study	Comparison	Grade	Outcomes	Studies	Sample Size	*k*	Effect Size	95% CI	*Z*-test	*p*-value
Duke et al. (2006)	NS	SBI vs. NIP	FT	Commitment to teaching	1	4952	1	.10	-.01, .21	14.21	.0068
Ingvarson et al. (2007)	NS	SBI vs. NIP	FT	Content knowledge preparedness	1	1147	1	-.10	-.23, .03	1.55	.1211
Ingvarson et al. (2007)	NS	SBI vs. NIP	FT	Preparedness in knowledge of students	1	1147	1	-.18	-.33, -.03	2.33	.0200
Kraft et al. (2018)	MA	SBM vs. NM	ST+	Teacher instruction	43	-	186	.49	.38, .60	8.71	.0000
Duke et al. (2006)	NS	SBM vs. NM	FT	Commitment to teaching	1	4952	1	.08	-.03, .19	1.48	.1378
Ingvarson et al. (2007)	NS	SBM vs. NM	FT	Knowledge preparedness	1	1147	1	.08	-.03, .19	1.44	.1500
Ingvarson et al. (2007)	NS	SBM vs. NM	FT	Student preparedness	1	1147	1	.20	.04, .36	2.57	.0102

NOTES. MA = Meta-analysis and NS = National survey. SBI = School-based teacher induction program, SBM = School-based mentoring, NIP = No teacher induction program, and NM = No faculty or school-based mentoring. FT = First year teacher outcomes, and ST = Second year teacher outcomes. *k*= Number of effect sizes and CI = Confidence interval.

Table S-23

Relationships Between School-Based Induction and Mentoring and University Student and Teacher Outcomes

Study	Type of Study	Comparison	Grade	Outcomes	Studies	Sample Size	*k*	Effect Size	95% CI	*Z*-test	*p*-value
Smith & Ingersoll (2004)	NS	GI(S) vs. NGI	FT	Attrition	1	3235	1	-.04	-.23, .16	.38	.7039
Smith & Ingersoll (2004)	NS	GI(C) vs. NGI	FT	Attrition	1	3235	1	-.31	-.46, -.15	3.89	.0001
Smith & Ingersoll (2004)	NS	GI(S) vs. NGI	FT	Attrition	1	3235	1	-.22	-.49, .05	1.63	.1031
Smith & Ingersoll (2004)	NS	GI(I) vs. NGI	FT	Attrition	1	3235	1	-.16	-.38, .06	1.42	.1556
Kraft et al. (2018)	MA	SBM vs. NM	ST+	K-12 Student Achievement	31	-	113	.18	.10, .25	4.81	.0000
DeAngelis et al. (2013)	NS	SMS vs. NM	FT	Moved within school district	1	884	1	-.03	-	-	-
DeAngelis et al. (2013)	NS	SMS vs. NM	FT	Moved to another school district	1	884	1	-.08	-	-	-
DeAngelis et al. (2013)	NS	SMS vs. NM	FT	Attrition	1	884	1	-.14	-	-	-
DeAngelis et al. (2013)	NS	SMD vs. NM	FT	Moved within school district	1	491	1	.05	-	-	-
DeAngelis et al. (2013)	NS	SMD vs. NM	FT	Moved to another school district	1	491	1	-.09	-	-	-
DeAngelis et al. (2013)	NS	SMD vs. NM	FT	Attrition	1	491	1	-.03	-	-	-

NOTES. MA = Meta-analysis and NS = National survey. GI(S) = Group induction seminars, GI(C) = Group induction collaborative planning, GI(S) = Group induction teacher support network, GI(I) = Group induction interpersonal teacher communication, SBM = School-based mentoring, SMS = School-based mentoring by teachers of same subject, SMD = School-based mentoring by teachers in a different subject, WPM = Workplace mentoring, WPC = Workplace coaching, NIP = No teacher induction program, NM = No faculty, school-based, or workplace mentoring, and NC = School-based or workplace coaching. U = University student outcome, FT = First year teacher outcomes, ST = Second year teacher outcomes, and CE = Career employee outcomes (other than teachers). *k*= Number of effect sizes and CI = Confidence interval.

Table S-23, continued.

Study	Type of Study	Comparison	Grade	Outcomes	Studies	Sample Size	*k*	Effect Size	95% CI	*Z*-test	*p*-value
DeAngelis et al. (2013)	NS	SMS vs. NM	ST	Moved within school district	1	884	1	.07	-	-	-
DeAngelis et al. (2013)	NS	SMS vs. NM	ST	Moved to another school district	1	884	1	-.06	-	-	-
DeAngelis et al. (2013)	NS	SMS vs. NM	ST	Attrition	1	884	1	-.12	-	-	-
DeAngelis et al. (2013)	NS	SMD vs. NM	ST	Moved within school district	1	491	1	.10	-	-	-
DeAngelis et al. (2013)	NS	SMD vs. NM	ST	Moved to another school district	1	491	1	-.06	-	-	-
DeAngelis et al. (2013)	NS	SMD vs. NM	ST	Attrition	1	491	1	-.02	-	-	-
Smith & Ingersoll (2004)	NS	SMS vs. NM	FT	Attrition	1	3235	1	-.19	-.41, .03	1.73	.0836
Smith & Ingersoll (2004)	NS	SMD vs. NM	FT	Attrition	1	3235	1	-.11	-1.05, .83	.23	.8181
Underhill (2006)	MA	WPM vs. NM	CE	Composite career outcomes	14	5449	88	.24	.17, .31	2.03	.0424
T. Allen et al. (2004)	MA	WPM vs. NM	CE	Career satisfaction	-	2602	7	.43	.26, .58	-	-
T. Allen et al. (2004)	MA	WPM vs. NM	CE	Expectations for advancement	-	691	3	.54	.47, .33	-	-

NOTES. MA = Meta-analysis and NS = National survey. GI(S) = Group induction seminars, GI(C) = Group induction collaborative planning, GI(S) = Group induction teacher support network, GI(I) = Group induction interpersonal teacher communication, SBM = School-based mentoring, SMS = School-based mentoring by teachers of same subject, SMD = School-based mentoring by teachers in a different subject, WPM = Workplace mentoring, WPC = Workplace coaching, NIP = No teacher induction program, NM = No faculty, school-based, or workplace mentoring, and NC = School-based or workplace coaching. U = University student outcome, FT = First year teacher outcomes, ST = Second year teacher outcomes, and CE = Career employee outcomes (other than teachers). *k*= Number of effect sizes and CI = Confidence interval.

Table S-23, continued.

Study	Type of Study	Comparison	Grade	Outcomes	Studies	Sample Size	*k*	Effect Size	95% CI	*Z*-test	*p*-value
T. Allen et al. (2004)	MA	WPM vs. NM	CE	Career commitment	-	2207	4	.30	.18, .45	-	-
T. Allen et al. (2004)	MA	WPM vs. NM	CE	Job satisfaction	-	3029	10	.37	.24, .52	-	-
T. Allen et al. (2004)	MA	WPM vs. NM	CE	Intention to stay	-	1606	3	.12	-.10, .35	-	-
Jones et al. (2016)	MA	WPC vs. NC	CE	Performance	14	2109	14	.31	.07, .55	2.55	.0108
Theeboom et al. (2014)	MA	WPC vs. NC	CE	Performance	6	2007	6	.60	.04, 1.16	2.10	.0357
Theeboom et al. (2014)	MA	WPC vs. NC	CE	Career commitment	11	789	11	.74	.42, 1.06	4.53	.0000
Theeboom et al. (2014)	MA	WPC vs. NC	CE	Attitudes	7	507	7	.54	.34, .73	5.57	.0000

NOTES. MA = Meta-analysis and NS = National survey. GI(S) = Group induction seminars, GI(C) = Group induction collaborative planning, GI(S) = Group induction teacher support network, GI(I) = Group induction interpersonal teacher communication, SBM = School-based mentoring, SMS = School-based mentoring by teachers of same subject, SMD = School-based mentoring by teachers in a different subject, WPM = Workplace mentoring, WPC = Workplace coaching, NIP = No teacher induction program, NM = No faculty, school-based, or workplace mentoring, and NC = School-based or workplace coaching. U = University student outcome, FT = First year teacher outcomes, ST = Second year teacher outcomes, and CE = Career employee outcomes (other than teachers). *k*= Number of effect sizes and CI = Confidence interval.

Table S-24

Relationships Between Different Teacher Preparation Practices and Teacher Attrition and Retention

Study	Type of Study	Comparison	Grade	Teacher Outcomes	Studies	Sample Size	*k*	Effect Size	95% CI	*Z*-test	*p*-value
Borman & Dowling (2008)	MA	MA vs. BA	K-12	Attrition	13	-	13	.06	.06, .07	11.76	.0000
Latham et. al (2015)	NS	PDS vs. TTP	FT/ST+	Retention	1	6649	1	.50	.43, .56	15.27	.0000
Borman & Dowling (2008)	MA	TC vs. NC	K-12	Attrition	3	-	3	-.54	-.55, -.53	105.86	.0000
Borman & Dowling (2008)	MA	IFC vs. OFC	K-12	Attrition	2	-	2	.38	.18, .57	3.83	.0000
Ronfeldt et al (2014)	NS	MC	K-5	Retention	1	967	1	.01	-.03, .06	.68	.4952
Ronfeldt et al (2014)	NS	MC	6-8	Retention	1	401	1	.04	-.05, .14	.94	.3483
Ronfeldt et al (2014)	NS	MC	9-12	Retention	1	1196	1	.00	-.05, .05	.02	.9841
Schmidt et al. (2009)	MA	PBL vs. TCI	U	Student graduation	1	9252	10	.33	-	-	-
Sneyers & Witte (2016)	MA	FM vs. NM	U	Student graduation	2	1720	2	.10	.01, .19	2.17	.0150
Sneyers & Witte (2016)	MA	FM vs. NM	U	First year retention	7	19271	7	.15	.06, .23	3.75	.0091
DeAngelis et al. (2013)	NS	MS vs. NM	FT	Attrition	1	884	1	-.14	-	-	-

NOTES. MA = Meta-analysis and NS = National survey. BA = Bachelors degree, MA = Masters degree, PDS = Professional development school, TTP = Traditional teacher education program, TC = Teacher certification, NC = No teacher certification, IFC = In-field teacher certification, OFC = Out-of-field teacher certification, MC = Methods courses, PBL = Problem-based learning, TCI = Traditional classroom instruction, FM = Faculty mentoring, NM = No faculty mentoring, MS = Mentoring in same subject, MD = Mentoring in different subject, SBM = School based mentoring, WPM = Workplace mentoring, FYS = First year college/university seminar, NIP = No teacher induction program, NM = No faculty, school based, or workplace mentoring, and NSS = No student seminar. U = University student outcome, FT = First year teacher outcomes, ST = Second year teacher outcomes and CE = Career employee outcomes (other than teachers). *k* = Number of effect sizes and CI = Confidence interval.

Table S-24, continued.

Study	Type of Study	Comparison	Grade	Teacher Outcomes	Studies	Sample Size	*k*	Effect Size	95% CI	*Z*-test	*p*-value
DeAngelis et al. (2013)	NS	MD vs. NM	FT	Attrition	1	491	1	-.03	-	-	-
DeAngelis et al. (2013)	NS	MS vs. NM	ST	Attrition	1	884	1	-.12	-	-	-
DeAngelis et al. (2013)	NS	MD vs. NM	ST	Attrition	1	491	1	-.02	-	-	-
Smith & Ingersoll (2004)	NS	MS vs. NM	FT	Attrition	1	3235	1	-.19	-.41, .03	1.73	.0836
Smith & Ingersoll (2004)	NS	MD vs. NM	FT	Attrition	1	3235	1	-.11	-1.05, .83	.23	.8181
Smith & Ingersoll (2004)	NS	FYS vs. NSS	FT	Attrition	1	3235	1	-.04	-.23, .16	.38	.7039
Permzadian & Crede (2016)	MA	FYS vs. NSS	U	First-year retention	195	169666	195	.11	-.11, .33	1.00	.3173

NOTES. MA = Meta-analysis and NS = National survey. BA = Bachelors degree, MA = Masters degree, PDS = Professional development school, TTP = Traditional teacher education program, TC = Teacher certification, NC = No teacher certification, IFC = In-field teacher certification, OFC = Out-of-field teacher certification, MC = Methods courses, PBL = Problem-based learning, TCI = Traditional classroom instruction, FM = Faculty mentoring, NM = No faculty mentoring, MS = Mentoring in same subject, MD = Mentoring in different subject, SBM = School based mentoring, WPM = Workplace mentoring, FYS = First year college/university seminar, NIP = No teacher induction program, NM = No faculty, school based, or workplace mentoring, and NSS = No student seminar. U = University student outcome, FT = First year teacher outcomes, ST = Second year teacher outcomes and CE = Career employee outcomes (other than teachers). *k*= Number of effect sizes and CI = Confidence interval.

References

Abrami, P. C., Bernard, R. M., Borokhovski, E., Waddington, D. I., Wade, C. A., & Persson, T. (2015). Strategies for teaching students to think critically: A meta-analysis. *Review of Educational Research, 85*(2), 275-314. doi:10.3102/0034654314551063

Aiello, N., & Wolfle, L. (1980). *A meta-analysis of individualized instruction in science*. Paper presented at the American Educational Research Association, Boston. Retrieved from https://files.eric.ed.gov/fulltext/ED190404.pdf

Akarsu, B., & Kaya, H. (2012). Redesigning effective methods courses: Teaching pre-service teachers how to teach. *Electronic Journal of Science Education, 16*(1).

Alegre-Ansuategui, F. J., Moliner, L., Lorenzo, G., & Maroto, A. (2018). Peer tutoring and academic achievement in mathematics: A meta-analysis. *Eurasia Journal of Mathematics, Science and Technology Education, 14*(1), 337-354. Retrieved from http://www.ejmste.com/Peer-Tutoring-and-Academic-Achievement-in-Mathematics-A-Meta-Analysis,79805,0,2.html doi:10.12973/ejmste/79805

Baeten, M., & Simons, M. (2014). Student teachers' team teaching: Models, effects, and conditions for implementation. *Teaching and Teacher Education, 41*, 92-110. doi:10.1016/j.tate.2014.03.010

Barnett, W. S. (2000). *Better teachers, better preschools: Student achievement linked to teacher qualifications*. New Brunswick, NJ: National Institute for Early Education Research. Retrieved from: https://eric.ed.gov/?id=ED480818.

Barrows, H. S. (1996). Problem-based learning in medicine and beyond: A brief overview. *New Directions for Teaching & Learning, 1996*(68), 3-12. doi:10.1002/tl.37219966804

Breidenstein, A. (2002). Examining the outcomes of four-year and extended teacher education programs. *Teacher Education and Practice, 15*(3), 12-43.

Burns, R. W., Jacobs, J., & Yendol-Hoppey, D. (2016). Preservice teacher supervision within field experiences in a decade of reform: A comprehensive meta-analysis of the empirical literature from 2001 to 2013. *Teacher Education and Practice, 29*(1), 46-75.

Castle, S. R., & McGuire, C. J. (2010). An analysis of student self-assessment of online, blended, and face-to-face learning environments: Implications for sustainable education delivery. *International Education Studies, 3*(3), 36-40. doi:10.5539/ies.v3n3p36

Clift, R. T., & Brady, P. (2005). Research on methods courses and field experiences. In M. Cochran-Smith & K. M. Zeichner (Eds.), *Studying teacher education: The report of the AERA Panel on Research and Teacher Education* (pp. 309-424). Mahwah, NJ: Lawrence Erlbaum.

Cohen, P., Ebeling, B., & Kulik, J. (1981). A meta-analysis of outcome studies of visual-based instruction. *Educational Communication and Technology Journal, 29*(1), 26-36.

Cook, D. A., Hamstra, S. J., Brydges, R., Zendejas, B., Szostek, J. H., Wang, A. T., . . . Hatala, R. (2013). Comparative effectiveness of instructional design features in simulation-based education: Systematic review and meta-analysis. *Medical Teacher, 35*, e867-898. Retrieved from https://www.tandfonline.com/doi/pdf/10.3109/0142159X.2012.714886

Darling-Hammond, L. (2006). Constructing 21st-century teacher education. *Journal of Teacher Education, 57*(3), 300-314. doi:10.1177/0022487105285962

Darling-Hammond, L. (2014). Strengthening clinical preparation: The holy grail of teacher education. *Peabody Journal of Education, 89*(4), 547-561. doi:10.1080/0161956X.2014.939009

Darling-Hammond, L., Berry, B., & Thoreson, A. (2001). Does teacher certification matter? Evaluating the evidence. *Educational Evaluation and Policy Analysis, 23*(1), 57-77. doi:10.3102/01623737023001057

DeNeve, K. M., & Heppner, M. J. (1997). Role play simulations: The assessment of an active learning technique and comparisons with traditional lectures. *Innovative Higher Education, 21*, 231-246. doi:10.1007/BF01243718

Donnelly, R., & Fitzmaurice, M. (2011). Towards productive reflective practice in microteaching. *Innovations in Education and Teaching International, 48*(3), 335-346. doi:10.1080/14703297.2011.593709

du Plessis, A. E. (2017). *Out-of-field teaching practices: What educational leaders need to know.* Rotterdam, The Netherlands: Sense.

Dunst, C. J., Hamby, D. W., Howse, R. B., Wilkie, H., & Annas, K. (2018). *Metasynthesis of preservice professional preparation and teacher education research studies.* Paper submitted for publication.

Freeman, S., Eddy, S. L., McDonough, M., Smith, M. K., Okoroafor, N., Jordt, H., & Wenderoth, M. P. (2014). Active learning increases student performance in science, engineering, and mathematics. *PNAS, 111*(23), 8410-8415. doi:10.1073/pnas.1319030111/-/DCSupplemental

Gormally, C., Evans, M., & Brickman, P. (2014). Feedback about teaching in higher ed: Neglected opportunities to promote change. *CBE—Life Sciences Education, 13*, 187-199. doi:10.1187/CBE.13-12-0235

Greenwald, A. (1997). Validity concerns and usefulness of student ratings of instruction. *American Psychologist, 52*, 1182-1186. doi:10.1037/0003-066X.52.11.1182

Guise, M., Habib, M., Thiessen, K., & Robbins, A. (2017). Continuum of co-teaching implementation: Moving from traditional student teaching to co-teaching. *Teaching and Teacher Education, 66*, 370-382. doi:10.1016.j.tate.2017.05.002

Heward, W. L. (1994). Three "low-tech" strategies for increasing the frequency of active student response during group instruction. In R. Gardner, D. M. Sainato, J. O. Cooper, T. E. Heron, W. L. Heward, J. Eshleman, & T. A. Gross (Eds.), *Behavior analysis in education: Focus on measurably superior instruction* (pp. 283-320). Monterey, CA: Brooks/Cole.

Howe, E. R. (2006). Exemplary teacher induction: An international review. *Educational Philosophy and Theory, 38*(3), 287-297.

Ingersoll, R., & Gruber, K. (1996). *Out-of-field teaching and educational equality.* Retrieved from https://files.eric.ed.gov/fulltext/ED402302.pdf

Isikoglu, N. (2008). The effects of a teaching methods course on early childhood preservice teachers' beliefs. *Journal of Early Childhood Teacher Education, 29*, 190-203. doi:10.1080/10901020802275260

Johnson, D. W., & Johnson, R. (1999). *Learning together and alone: Cooperative, competitive, and individualistic learning* (5th ed.). Boston: Allyn & Bacon.

Katz, Y. J. (1999). Kindergarten teacher training through virtual reality: Three-dimensional simulation methodology. *Educational Media International, 36*, 151-156.

Kemmis, S., Heikkinen, H. L. T., Fransson, G., Aspfors, J., & Edwards-Groves, C. (2014). Mentoring of new teachers as a contested practice: Supervision, support and collaborative self-development. *Teaching and Teacher Education, 43*, 154-164. doi:10.1016/j.tate.2014.07.001

Kim, J., Park, J.-H., & Shin, S. (2016). Effectiveness of simulation-based nursing education depending on fidelity: A meta-analysis. *BMC Medical Education, 16*. doi:10.1186/s12909-016-0672-7

Larwin, K. H., & Larwin, D. A. (2013). The impact of guided notes on post-secondary student achievement: A meta-analysis. *International Journal of Teaching and Learning in Higher Education, 25*(1), 47-58.

Levin, B. B. (1995). Using the case method in teacher education: The role of discussion and experience in teachers' thinking about cases. *Teaching and Teacher Education, 11*, 63-79.

Mandinach, E. B., & Cline, H. F. (1993). *Classroom dynamics: Implementing a technology-based learning environment*. New York: Routledge.

McGaghie, W. C., Issenberg, B., Cohen, E. R., Barsuk, J. H., & Wayne, D. B. (2011). Does simulation-based medical education with deliberate practice yield better results than traditional clinical education? A meta-analytic comparative review of the evidence. *Academic Medicine, 86*(6), 706-711. doi:10.1097IACM.0b013e318217e119

Merchant, Z., Goetz, E. T., Cifuentes, L., Keeney-Kennicutt, W., & Davis, T. J. (2014). Effectiveness of virtual reality-based instruction on students' learning outcomes in K-12 and higher education: A meta-analysis. *Computers & Education, 70*, 29-40. doi:10.1016/j.compedu.2013.07.033

Metcalf, K. K. (1995, April). *Laboratory experiences in teacher education: A meta-analytic review of research.* Paper presented at the Annual Meeting of the American Educational Research Association, San Francisco, CA. Retrieved from https://files.eric.ed.gov/fulltext/ED388645.pdf

National Board for Professional Teaching Standards. (2018). *Guide to national board certification, Version 2.6*. New York: Pearson. Retrieved from http://www.nbpts.org/wp-content/uploads/Guide_to_NB_Certification.pdf

Piper, A. W. (2007). What we know about integrating early childhood education and early childhood special education teacher preparation programs: A review, a reminder and a request. *Journal of Early Childhood Teacher Education, 28*(2), 163-180. doi:10.1080/10901020701366749

Prince, M., & Felder, R. (2007). The many faces of inductive teaching and learning. *Journal of College Science Teaching, 36*(5), 14-20.

Qu, Y., & Becker, B. J. (2003). *Does traditional teacher certification imply quality? A meta-analysis*. Paper presented at the Annual Meeting of the American Educational Research Association, Chicago, IL. Retrieved from https://files.eric.ed.gov/fulltext/ED477460.pdf.

Saracho, O. N. (2013). Early childhood teacher preparation programmes in the USA. *Early Child Development and Care, 183*(5), 571-588. doi:10.1080/03004430.2012.673488

Schmid, R. F., Bernard, R. M., Borokhovski, E., Tamim, R. M., Abrami, P. C., Surkes, M. A., . . . Woods, J. (2014). The effects of technology use in postsecondary education: A meta-analysis of classroom applications. *Computers & Education, 72*, 271-291. doi:10.1016/j.compedu.2013.11.002

Schmidt, F. L., & Oh, I.-S. (2013). Methods for second-order meta-analysis and illustrative applications. *Organizational Behavior and Human Decision Processes, 121*, 204-218. doi:10.1016/j.obhdp.2013.03.002

Sen, A. (2009). A study on the effectiveness of peer microteaching in a teacher education program. *Education and Science, 34*(151), 165-174.

Slavin, R. E. (1996). Research on cooperative learning and achievement: What we know, what we need to know. *Contemporary Educational Psychology, 21*, 43-69. doi:10.1006/ceps.1996.0004

Stayton, V. D., Smith, B. J., Dietrich, S. L., & Bruder, M. B. (2012). Comparison of state certification and professional association personnel standards in early childhood special education. *Topics in Early Childhood Special Education, 32*(1), 24-37. doi:10.1177/0271121411436086

Steenbergen-Hu, S., & Cooper, H. (2014). A meta-analysis of the effectiveness of intelligent tutoring systems on college students' academic learning. *Journal of Educational Psychology, 106*(2), 331-347. doi:10.1037/a0034752

Strong, M. (2009). *Effective teacher induction and mentoring: Assessing the evidence*. New York: Teachers College Press.

Teach for America. (2018). *Getting certified: Learn about the requirements and steps toward teacher certification that corps members complete.* New York: Author. Retrieved from https://www.teachforamerica.org/join-tfa/leading-classroom/training-and-development/getting-certified

Tosey, P., & Gregory, J. (1998). The peer learning community in higher education: Reflections on practice. *Innovations in Education and Training International, 35*, 74-81.

Wales, C. E., & Stager, R. A. (1978). *The guided design approach.* Englewood Cliffs, NJ: Educational Technology Publications.

Wasim, J., Sharma, S. K., Khan, I. A., & Siddiqui, J. (2014). Web based learning. *International Journal of Computer Science and Information Technologies, 5*(1), 446-449.

Whitebook, M. (2003). *Bachelor's degrees are best: Higher qualifications for pre-kindergarten teachers lead to better learning environments for children.* Washington, DC: The Trust for Early Education.

Whitford, D. K., Zhang, D., & Katsiyassis, A. (2018). Traditional vs. alternative teacher preparation programs: A meta-analysis. *Journal of Child and Family Studies, 27*(3), 671-685. doi:10.1007/s10826-017-0932-0

Wittwer, J., & Renkl, A. (2010). How effective are instructional explanations in example-based learning? A meta-analytic review. *Educational Psychology Review, 22*, 393-409. doi:10.1007/s10648-010-9136-5

Worrell, F. C., Brabeck, M. M., Dwyer, C., Geisinger, K. F., Marx, R. W., Noell, G. H., & Pianta, R. C. (2014). *Assessing and evaluating teacher preparation programs.* Washington, D. C.: American Psychological Association.

Yang, L. (2017). Meta-analysis of the impact of service learning on students from statistical perception. *Research on Modern Higher Education, 3*, 87-89.

Appendix A

Meta-Analyses and Surveys Included in the Metasynthesis

Abrami, P. C., Bernard, R. M., Borokhovski, E., Waddington, D. I., Wade, C. A., & Persson, T. (2015). Strategies for teaching students to think critically: A meta-analysis. *Review of Educational Research, 85*(2), 275-314. doi:10.3102/0034654314551063

Aiello, N., & Wolfle, L. (1980). *A meta-analysis of individualized instruction in science.* Paper presented at the American Educational Research Association, Boston. Retrieved from https://files.eric.ed.gov/fulltext/ED190404.pdf

Alegre-Ansuategui, F. J., Moliner, L., Lorenzo, G., & Maroto, A. (2018). Peer tutoring and academic achievement in mathematics: A meta-analysis. *Eurasia Journal of Mathematics, Science and Technology Education, 14*(1), 337-354. Retrieved from http://www.ejmste.com/Peer-Tutoring-and-Academic-Achievement-in-Mathematics-A-Meta-Analysis,79805,0,2.html doi:10.12973/ejmste/79805

Alfieri, L., Brooks, P. J., Aldrich, N. J., & Tenenbaum, H. R. (2011). Does discovery-based instruction enhance learning? *Journal of Educational Psychology, 103*(1), 1-18. doi:10.1037/a002101

Allen, M., Bourhis, J., Burrell, N., & Mabry, E. (2002). Comparing student satisfaction with distance education to traditional classrooms in higher education: A meta-analysis. *The American Journal of Distance Education, 16*(2), 83-97.

Allen, M., Mabry, E., Mattrey, M., Bourhis, J., Titsworth, S., & Burrell, N. (2004). Evaluating the effectiveness of distance learning: A comparison using meta-analysis. *Journal of Communication, 54*(3), 402-420.

Allen, T. D., Eby, L. T., Poteet, M. L., Lentz, E., & Lima, L. (2004). Career benefits associated with mentoring for protégés: A meta-analysis. *Journal of Applied Psychology, 89*(1), 127-136. doi:10.1037/0021-9010.89.1.127

Anderson, R. D., Kohl, S., M. L. Smith, M. L., & Glass, G. V. (1982). *Science meta-analysis: Final report of NSF Project No. SED 80-12310, Volume I and II.* Boulder, CO: Laboratory for Research in Science and Mathematics Education, University of Colorado.

Andrew, M. D., & Schwab, R. L. (1995). Has reform in teacher education influenced teacher performance? An outcome assessment of graduates of an eleven-university consortium. *Action in Teacher Education, 17*(3), 43-53. doi:10.1080/01626620.1995.10463255

Ayaz, M. F., & Söylemez, M. (2015). The effect of the project-based learning approach on the academic achievements of the students in science classes in Turkey: A meta-analysis study. *Education and Science, 40*(178), 255-283. Retrieved from https://www.researchgate.net/publication/275959212_The_Effect_of_the_Project-Based_Learning_Approach_on_the_Academic_Achievements_of_the_Students_in_Science_Classes_in_Turkey_A_Meta-Analysis_Study doi:10.15390/EB.2015.4000

Azevedo, R., & Bernard, R. M. (1995). *The effects of computer-presented feedback on learning from computer-based instruction: A meta-analysis.* Paper presented at the Annual Meeting of the American Educational Research Association, San Francisco, CA.

Baker, S. B., & Daniels, T. G. (1989). Integrating research on the microcounseling program: A meta-analysis. *Journal of Counseling Psychology, 36*(2), 213-222. doi:10.1037/0022-0167.36.2.213

Baker, T. E., & Andrew, M. D. (1993). *An eleven institution study of four-year and five-year teacher education program graduates.* Paper presented at the Annual Meeting of the Association of Teacher Educators, Los Angeles. Retrieved from https://files.eric.ed.gov/fulltext/ED355224.pdf

Balta, N., Michinov, N., Balyimez, S., & Ayaz, M. F. (2017). A meta-analysis of the effect of peer instruction on learning gain: Identification of informational and cultural moderators. *International Journal of Educational Research, 86*, 66-77. doi:10.1016/j.ijer.2017.08.009

Bangert-Drowns, R. L., Kulik, C. C., Kulik, J. A., & Morgan, M. T. (1991). The instructional effect of feedback in test-like events. *Review of Educational Research, 61*(2), 213-238. doi:10.3102/00346543061002213

Bayraktar, S. (2002). A meta-analysis of the effectiveness of computer-assisted instruction in science education. *Journal of Research on Technology in Education, 34*(2), 173-188. doi:10.1080/15391523.2001.10782344

Benz, B. F. (2010). *Improving the quality of e-learning by enhancing self-regulated learning: A synthesis of research on self-regulated learning and an implementation of a scaffolding concept.* (Doctoral Dissertation), Technische Universität Darmstadt, Darmstadt, Germany.

Bernard, R. M., Abrami, P. C., Lou, Y., Borokhovski, E., Wade, A., Wozney, L., . . . Huang, B. (2004). How does distance education compare to classroom instruction? A meta-analysis of the empirical literature. *Review of Educational Research, 74*(3), 379-439. doi:10.3102/00346543074003379

Bernard, R. M., Borokhovski, E., Schmid, R. F., Tamim, R. M., & Abrami, P. C. (2014). A meta-analysis of blended learning and technology use in higher education: from the general to the applied. *Journal of Computing in Higher Education, 26*, 87-122.

Boe, E., Shin, S., & Cook, L. H. (2007). Does teacher preparation matter for beginning teachers in either special or general education? *Journal of Special Education, 41*(3), 158-170. doi:10.1177/00224669070410030201

Borman, G. D., & Dowling, N. M. (2008). Teacher attrition and retention: A meta-analytic and narrative review of the research. *Review of Educational Research, 78*(3), 367-409. doi:10.3102/0034654308321455

Bowen, C. W. (2000). A quantitative literature review of cooperative learning effects on high school and college chemistry achievement. *Journal of Chemical Education, 77*(1), 116-119. doi:10.1021/ed077p116

Butcher, P. M. (1981). *An experimental investigation of the effectiveness of a value claim strategy unit for use in teacher education* (Master's Thesis), Macquarie University, Sydney, Australia.

Camnalbur, M., & Erdoğan, Y. (2008). A meta analysis on the effectiveness of computer-assisted instruction: Turkey sample. *Educational Sciences: Theory & Practice, 8*(2), 497-505.

Capar, G., & Tarim, K. (2015). Efficacy of the cooperative learning method on mathematics achievement and attitude: A meta-analysis research. *Educational Sciences: Theory & Practice, 15*(2), 553-559. doi:10.12738/estp.2015.2.2098

Castillo-Manzano, J. I., Castro-Nuño, M., López-Valpuesta, L., Sanz-Díaz, M., & Yñiguez, R. (2016). Measuring the effect of ARS on academic performance: A global meta-analysis. *Computers & Education, 96*, 109-121. doi:10.1016/j.compedu.2016.02.007

Cohen, P. (1980). Effectiveness of student rating feedback for improving college instruction: A meta-analysis of findings. *Research in Higher Education, 13*, 321-341. doi:10.1007/BF00976252

Cohen, P., Ebeling, B., & Kulik, J. (1981). A meta-analysis of outcome studies of visual-based instruction. *Educational Communication and Technology Journal, 29*(1), 26-36.

Cook, D. A., Hamstra, S. J., Brydges, R., Zendejas, B., Szostek, J. H., Wang, A. T., . . . Hatala, R. (2013). Comparative effectiveness of instructional design features in simulation-based education: Systematic review and meta-analysis. *Medical Teacher, 35*, e867-898. Retrieved from https://www.tandfonline.com/doi/pdf/10.3109/0142159X.2012.714886

Cook, D. A., Levinson, A. J., Garside, S., Dupras, D. M., Erwin, P. J., & Montori, V. M. (2010). Instructional design variations in internet-based learning for health professions education: A systematic review and meta-analysis. *Academic Medicine, 85*(5), 909-922.

Credé, M., Roch, S. G., & Kieszczynka, U. M. (2010). Class attendance in college: A meta-analytic review of the relationship of class attendance with grades and student characteristics. *Review of Educational Research, 80*(2), 272-295. doi:10.3102/0034654310362998

DeAngelis, K. J., Wall, A. F., & Che, J. (2013). The impact of preservice preparation and early career support on novice teachers' career intentions and decisions. *Journal of Teacher Education, 64*(4), 338-355. doi:10.1177/0022487113488945

Dochy, F., Segers, M., Van den Bossche, P., & Gijbels, D. (2003). Effects of problem-based learning: A meta-analysis. *Learning and Instruction, 13*(5), 533-568. doi:10.1016/S0959-4752(02)00025-7

Druva, C. A., & Anderson, R. D. (1983). Science teacher characteristics by teacher behavior and by student outcome: A meta-analysis of research. *Journal of Research in Science Teaching, 20*(5), 467-479. doi:10.1002/tea.3660200509

Duke, L., Karson, A., & Wheeler, J. (2006). Do mentoring and induction programs have greater benefits for teachers who lack preservice training? *Journal of International and Public Affairs, 17*, 61-82. Retrieved from https://jpia.princeton.edu/sites/jpia/files/2006-4.pdf

Dunst, C. J., Trivette, C. M., & Hamby, D. W. (2010). Meta-analysis of the effectiveness of four adult learning methods and strategies. *International Journal of Continuing Education and Lifelong Learning, 3*(1), 91-112. Retrieved from http://hdl.voced.edu.au/10707/41

Early, D. M., Maxwell, K. L., Burchinal, M., Alva, S., Bender, R. H., Bryant, D., . . . Zill, N. (2007). Teachers' education, classroom quality, and young children's academic skills: Results from seven studies of preschool programs. *Child Development, 78*, 558-580. doi:10.1111/j.1467-8624.2007.01014.x

Eby, L. T., Allen, T. D., Evans, S. C., Ng, T., & DuBois, D. L. (2008). Does mentoring matter? A multidisciplinary meta-analysis comparing mentored and non-mentored individuals. *Journal of Vocational Behavior, 72*(2), 254-267. doi:10.1016/j.jvb.2007.04.005

Falenchuk, O., Perlman, M., McMullen, E., Fletcher, B., & Shah, P. S. (2017). Education of staff in preschool aged classrooms in child care centers and child outcomes: A meta-analysis and systematic review. *PLoS ONE, 12*(8), e0183673. Retrieved from https://doi.org/10.1371/journal.pone.0183673 doi:10.1371/journal.pone.0183673

Fletcher-Flinn, C. M., & Gravatt, B. (1995). The efficacy of computer assisted instruction (CAI): A meta-analysis. *Journal of Educational Computing Research, 12*(3), 219-242. doi:10.2190/51D4-F6L3-JQHU-9M31

Freeman, S., Eddy, S. L., McDonough, M., Smith, M. K., Okoroafor, N., Jordt, H., & Wenderoth, M. P. (2014). Active learning increases student performance in science, engineering, and mathematics. *PNAS, 111*(23), 8410-8415. doi:10.1073/pnas.1319030111/-/DCSupplemental

Fukkink, R. G., Trienekens, N., & Kramer, L. J. C. (2011). Video feedback in education and training: Putting learning in the picture. *Educational Psychology Review, 23*, 45-63. doi:10.1007/s10648-010-9144-5

Gijbels, D., Dochy, F., Van den Bossche, P., & Segers, M. (2005). Effects of problem-based learning: A meta-analysis from the angle of assessment. *Review of Education Research, 75*, 27-61. doi:10.3102/00346543075001027

Gliessman, D. H., Pugh, R. C., Dowden, D. E., & Hutchins, T. F. (1988). Variables influencing the acquisition of a generic teaching skill. *Review of Educational Research, 58*(1), 25-46. doi:10.3102/00346543058001025

Gong, X. (2015). *Does having a preschool teacher with a bachelor's degree matter for children's developmental outcomes?* (Doctoral Dissertation), Columbia University, New York. Retrieved from https://core.ac.uk/download/pdf/158157910.pdf

Greenwald, R., Hedges, L. V., & Laine, R. D. (1996). The effect of school resources on student achievement. *Review of Education Research, 66*(3), 361-396. doi:10.3102/00346543066003361

Hacke, W. (2010). *Meta-analysis comparing student outcomes for national board certified teachers and non-national board certified teachers* (Doctoral Dissertation), University of San Francisco, San Francisco. Retrieved from https://repository.usfca.edu/cgi/viewcontent.cgi?article=1384&context=diss

Hatala, R., Cook, D. A., Zendejas, B., Hamstra, S. J., & Brydges, R. (2013). Feedback for simulation-based procedural skills training: A meta-analysis and clinical narrative synthesis. *Advances in Health Sciences Education, 19*(2), 251-272. doi:10.1007/s10459-013-9462-8

Henk, W. A., & Stahl, N. A. (1985, November). *A meta-analysis of the effect of notetaking on learning from lecture. College reading and learning assistance.* Paper presented at the Annual Meeting of the National Reading Conference, St. Petersburg Beach, FL. Retrieved from https://files.eric.ed.gov/fulltext/ED258533.pdf

Hsu, Y. (2003). *The effectiveness of computer-assisted instruction in statistics education: A meta-analysis.* (Doctoral Dissertation), University of Arizona, Tucson, AZ.

Huddy, W. P. (2012). *A meta-analytic review of cooperative learning practices in higher education: A human communication perspective.* (Doctoral Dissertation), University of Denver, Denver, CO. Retrieved from https://digitalcommons.du.edu/cgi/viewcontent.cgi?article=1296&context=etd

Ingvarson, L., Beavis, A., & Kleinhenz, E. (2007). Factors affecting the impact of teacher education programmes on teacher preparedness: Implications for accreditation policy. *European Journal of Teacher Education, 30*, 351-381. doi:10.1080/02619760701664151

Jahng, N., Krug, D., & Zhang, Z. (2007). Student achievement in online distance education compared to face-to-face education. *European Journal of Open, Distance and E-Learning.* Retrieved from http://www.eurodl.org/materials/contrib/2007/Jahng_Krug_Zhang.pdf

Johnson, D. W., Maruyama, G., Johson, R., Nelson, D., & Skon, L. (1981). Effects of cooperative, competitive, and individualistic goal structures on achievement: A meta-analysis. *Psychological Bulletin, 89*(1), 47-62. doi:10.1037/0033-2909.89.1.47

Jones, R. J., Woods, S. A., & Guillaume, Y. R. F. (2016). The effectiveness of workplace coaching: A meta-analysis of learning and performance outcomes from coaching. *Journal of Occupational and Organizational Psychology, 89*, 249-277. doi:10.1111/joop.12119

Jurewitsch, B. (2012). A meta-analytic and qualitative review of online versus face-to-face problem-based learning. *International Journal of E-Learning & Distance Education, 26*(2).

Kalaian, S. A., & Kasim, R. A. (2014). A meta-analytic review of studies of effectiveness of small-group learning on statistics achievement. *Journal of Statistics Education, 22*(1). doi:10.1080/10691898.2014.11889691

Karich, A. C., Burns, M. K., & Maki, K. E. (2014). Updated meta-analysis of learner control within educational technology. *Review of Educational Research, 84*(3), 392-410. doi:10.3102/0034654314526064

Kelley, P., & Camilli, G. (2007). *The impact of teacher education on outcomes in center-based early childhood education programs: A meta-analysis.* New Brunswick, NJ: National Institute for Early Education Research. Retrieved from http://nieer.org/

Kim, J., Park, J.-H., & Shin, S. (2016). Effectiveness of simulation-based nursing education depending on fidelity: A meta-analysis. *BMC Medical Education, 16*. doi:10.1186/s12909-016-0672-7

Kluger, A. N., & DeNisi, A. (1996). The effects of feedback interventions on performance: A historical review, a meta-analysis, and a preliminary feedback intervention theory. *Psychological Bulletin, 119*(2), 254-284. doi:10.1037/0033-2909.119.2.254

Kobayashi, K. (2005). What limits the encoding effect of note-taking? A meta-analytic examination. *Contemporary Educational Psychology, 30*, 242-262. doi:10.1016/j.cedpsych.2004.10.001

Koufogiannakis, D., & Wiebe, N. (2006). Effective methods for teaching information literacy skills to undergraduate students: A systematic review and meta-analysis. *Evidence Based Library and Information Practice, 1*(3). doi:10.18438/B8MS3D

Kraft, M. A., Blazar, D., & Hogan, D. (2018). The effect of teacher coaching on instruction and achievement: A meta-analysis of the causal evidence. *Review of Educational Research, 88*(4), 547-588. doi:10.3102/0034654318759268

Kulik, C. C., & Kulik, J. A. (1991). Effectiveness of computer-based instruction: An updated analysis. *Computers in Human Behavior, 7*, 75-94. doi:10.1016/0747-5632(91)90030-5

Kulik, J., Kulik, C., & Cohen, P. (1979a). A meta-analysis of outcome studies of Keller's personalized system of instruction. *American Psychologist, 34*(4), 307-318. doi:10.1037/0003-066X.34.4.307

Kulik, J., Kulik, C., & Cohen, P. (1979b). Research on audio-tutorial instruction: A meta-analysis of comparative studies. *Research in Higher Education, 11*(4), 321-341. doi:10.1007/BF00975623

Kulik, J., Kulik, C., & Cohen, P. (1980). Effectiveness of computer-based college teaching: A meta-analysis of findings. *Review of Educational Research, 50*(4), 525-544. doi:10.3102/00346543050004525

Kulik, J. A., Cohen, P. A., & Ebeling, B. J. (1980). Effectiveness of programmed instruction in higher education: A meta-analysis of findings. *Educational Evaluation and Policy Analysis, 2*(6), 51-64. doi:10.3102/01623737002006051

Kulik, J. A., & Kulik, C. C. (1988). Timing of feedback and verbal learning. *Review of Educational Research, 58*(1), 79-97. doi:10.3102/00346543058001079

Larwin, K. H., Gorman, J., & Larwin, D. A. (2013). Assessing the impact of testing aids on post-secondary student performance: A meta-analytic investigation. *Educational Psychology Review, 25*, 429-443. doi:10.1007/s10648-013-9227-1

Larwin, K. H., & Larwin, D. A. (2013). The impact of guided notes on post-secondary student achievement: A meta-analysis. *International Journal of Teaching and Learning in Higher Education, 25*(1), 47-58.

Latham, N., Mertens, S. B., & Hamann, K. (2015). A comparison of teacher preparation models and implications for teacher attrition: Evidence from a 14-year longitudinal study. *School-University Partnerships, 8*(2), 79-89.

Leary, H., Walker, A., Shelton, B. E., & Fitt, M. H. (2013). Exploring the relationships between tutor background, tutor training, and student learning: A problem-based learning meta-analysis. *Interdisciplinary Journal of Problem-Based Learning, 7*(1), 40-66. doi:10.7771/1541-5015.1331

Leary, H. M. (2012). *Self-directed learning in problem-based learning versus traditional lecture-based learning: A meta-analysis* (Doctoral Dissertation), Utah State University, Logan, UT. Retrieved from https://www.researchgate.net/publication/267988290

Leung, K. C. (2015). Preliminary empirical model of crucial determinants of best practice for peer tutoring on academic achievement. *Journal of Educational Psychology, 107*(2), 558-579. doi:10.1037/a0037698

Liu, H.-Y., & Chang, C.-C. (2017). Effectiveness of 4Ps creativity teaching for college students: A systematic review and meta-analysis. *Creative Education, 8*, 857-869. doi:10.4236/ce.2017.86062

Liu, S.-N. C., & Beaujean, A. A. (2017). The effectiveness of team-based learning on academic outcomes: A meta-analysis. *Scholarship of Teaching and Learning in Psychology, 3*(1), 1-14. doi:10.1037/stl0000075

Lou, Y., Abrami, P., & d'Apollonia, S. (2001). Small group and individual learning with technology: A meta-analysis. *Review of Educational Research, 71*(3), 449-521.

Lou, Y., Abrami, P. C., Spence, J. C., Poulsen, C., Chambers, B., & D'Apollonia, S. (1996). Within-class grouping: A meta-analysis. *Review of Educational Research, 66*(4), 423-458. doi:10.3102/00346543066004423

Malone, M. R. (1984). *Project MAFEX: How effective are field experience in science education?*. Paper presented at the annual conference of the National Association for Research in Science Teaching, New Orleans, LA.

Manning, M., Garvis, S., Fleming, C., & Wong, G. T. W. (2017). The relationship between teacher qualification and the quality of the early childhood education and care environment. *Campbell Systematic Reviews, 2017*(1), 1-82. doi:10.4073/csr.2017.1

McGaghie, W. C., Issenberg, B., Cohen, E. R., Barsuk, J. H., & Wayne, D. B. (2011). Does simulation-based medical education with deliberate practice yield better results than traditional clinical education? A meta-

analytic comparative review of the evidence. *Academic Medicine, 86*(6), 706-711. doi:10.1097IACM.0b013e318217e119

Means, B., Toyama, Y., Murphy, R., & Baki, M. (2013). The effectiveness of online and blended learning: A meta-analysis of the empirical literature. *Teachers College Record, 115*(3), 1-47.

Menges, R., & Brinko, K. (1986, April). *Effects of student evaluation feedback: A meta-analysis of higher education research.* Paper presented at the American Educational Research Association, San Francisco. Retrieved from https://files.eric.ed.gov/fulltext/ED270408.pdf

Merchant, Z., Goetz, E. T., Cifuentes, L., Keeney-Kennicutt, W., & Davis, T. J. (2014). Effectiveness of virtual reality-based instruction on students' learning outcomes in K-12 and higher education: A meta-analysis. *Computers & Education, 70*, 29-40. doi:10.1016/j.compedu.2013.07.033

Metcalf, K. K. (1995, April). *Laboratory experiences in teacher education: A meta-analytic review of research.* Paper presented at the Annual Meeting of the American Educational Research Association, San Francisco, CA. Retrieved from https://files.eric.ed.gov/fulltext/ED388645.pdf

Michko, G. M. (2008). *Meta-analysis of effectiveness of technology use in undergraduate engineering education.* Paper presented at the 38th ASEE/IEEE Frontiers in Education Conference, Saratoga Springs, NY. Retrieved from http://icee.usm.edu/icee/conferences/FIEC2008/papers/1378.pdf

Monk, D. H. (1994). Subject area preparation of secondary mathematics and science teachers and student achievement. *Economics of Education Review, 13*(2), 125-145. doi:10.1016/0272-7757(94)90003-5

Mothibi, G. (2015). A meta-analysis of the relationship between e-learning and students' academic achievement in higher education. *Journal of Education and Practice, 6*(9), 6-9.

Murad, M. H., Coto-Yglesias, F., Varkey, P., Prokop, L. J., & Murad, A. L. (2010). The effectiveness of self-directed learning in health professions education: A systematic review. *Medical Education, 44*, 1057-1068.

Niu, L., Behar-Horenstein, L. S., & Garvan, C. W. (2013). Do instructional interventions influence college students' critical thinking skills? A meta-analysis. *Educational Research Review, 9*, 114-128. doi:10.1016/jedurev.2012.12.002

Novak, J. M., Markey, V., & Allen, M. (2007). Evaluating cognitive outcomes of service learning in higher education: A meta-analysis. *Communication Research Reports, 24*(2), 149-157. doi:10.1080/08824090701304881

Pai, H.-H., Sears, D. A., & Maeda, Y. (2015). Effects of small-group learning on transfer: A meta-analysis. *Educational Psychology Review, 27*, 79-102. doi:10.1007/s10648-014-9260-8

Parsons, J. A. (1991). *A meta-analysis of learner control in computer-based learning environments.* (Doctoral Dissertation), Nova Southeastern University, Fort Lauderdale, FL. Retrieved from http://nsuworks.nova.edu/gscis_etd/765

Penny, A. R., & Coe, R. (2004). Effectiveness of consultation on student ratings feedback: A meta-analysis. *Review of Education Research, 74*(2), 215-253. doi:10.3102/00346543074002215

Permzadian, V., & Credé, M. (2016). Do first-year seminars improve college grades and retention? A quantitative review of their overall effectiveness and an examination of moderators of effectiveness. *Review of Educational Research, 86*(1), 277-316. doi:10.3102/0034654315584955

Qu, Y., & Becker, B. J. (2003). *Does traditional teacher certification imply quality? A meta-analysis.* Paper presented at the Annual Meeting of the American Educational Research Association, Chicago, IL. Retrieved from https://files.eric.ed.gov/fulltext/ED477460.pdf.

Rees, E., Quinn, P. J., Davies, B., & Fotheringham, V. (2016). How does peer teaching compare to faculty teaching? A systematic review and meta-analysis. *Medical Teacher, 38*, 829-837. doi:10.3109/0142159X.2015.1112888

Roberts, R. M. (2011). *Best instructional practices for distance education: A meta-analysis.* (Doctoral Dissertation), University of Nevada, Las Vegas, Las Vegas, NV. Retrieved from https://digitalscholarship.unlv.edu/cgi/viewcontent.cgi?article=2239&context=thesesdissertations

Ronfeldt, M., Schwartz, N., & Jacob, B. (2014). Does pre-service preparation matter? Examining an old question in new ways. *Teachers College Record, 116*(10), 1-46.

Schenker, J. D. (2007). *The effectiveness of technology use in statistics instruction in higher education: A meta-analysis using hierarchical linear modelling.* (Doctoral Dissertation), Kent State University, Kent, OH.

Schmid, R. F., Bernard, R. M., Borokhovski, E., Tamim, R., Abrami, P. C., Wade, C. A., . . . Lowerison, G. (2009). Technology's effect on achievement in higher education: A stage I meta-analysis of classroom applications. *Journal of Computing in Higher Education, 21*, 95-109. doi:10.1007/s12528-009-9021-8

Schmid, R. F., Bernard, R. M., Borokhovski, E., Tamim, R. M., Abrami, P. C., Surkes, M. A., . . . Woods, J. (2014). The effects of technology use in postsecondary education: A meta-analysis of classroom applications. *Computers & Education, 72*, 271-291. doi:10.1016/j.compedu.2013.11.002

Schmidt, H. G., van der Molen, H. T., te Winkel, W. W. R., & Wijnen, W. H. F. W. (2009). Constructivist, problem-based learning does work: A meta-analysis of curricular comparisons involving a single medical school. *Educational Psychologist, 44*(4), 227-249. doi:10.1080/00461520903213592

Shachar, M., & Neumann, Y. (2010). Twenty years of research on the academic performance differences between traditional and distance learning: Summative meta-analysis and trend examination. *MERLOT Journal of Online Learning and Teaching, 6*(2), 318-334.

Sitzmann, T., Kraiger, K., Stewart, D., & Wisher, R. (2006). The comparative effectiveness of web-based and classroom instruction: A meta-analysis. *Personnel Psychology, 59*, 623-664. doi:10.1111/j.1744-6570.2006.00049.x

Smith, T. M., & Ingersoll, R. M. (2004). What are the effects of induction and mentoring on beginning teacher turnover? *American Educational Research Journal, 41*(3), 681-714. Retrieved from http://repository.upenn.edu/gse_pubs/135 doi:10.3102/00028312041003681

Sneyers, E., & De Witte, K. (2018). Interventions in higher education and their effect on student success: A meta-analysis. *Educational Review, 70*(2), 208-228.

Sosa, G. W., Berger, D. E., Saw, A. T., & Mary, J. C. (2011). Effectiveness of computer-assisted instruction in statistics: A meta-analysis. *Review of Educational Research, 81*(1), 97-128. doi:10.3102/0034654310378174

Sparks, K. (2004). *The effect of teacher certification on student achievement* (Doctoral Dissertation), Texas A&M University, College Station, TX. Retrieved from https://dspacepre1.library.tamu.edu/bitstream/handle/1969.1/2229/etd-tamu-2004A-EPSY-Sparks-1.pdf?sequence=1

Springer, L., Stanne, M., & Donovan, S. (1999). Effects of small group learning on undergraduates in science, mathematics, engineering, and technology: A meta-analysis. *Review of Educational Research, 69*(1), 21-51. doi:10.3102/00346543069001021

Steenbergen-Hu, S., & Cooper, H. (2014). A meta-analysis of the effectiveness of intelligent tutoring systems on college students' academic learning. *Journal of Educational Psychology, 106*(2), 331-347. doi:10.1037/a0034752

Sweitzer, G. L., & Anderson, R. D. (1983). A meta-analysis of research on science teacher education practices associated with inquiry strategy. *Journal of Research in Science Teaching, 20*(5), 453-466. doi:10.1002/tea.3660200508

Theeboom, T., Beersma, B., & van Vianen, A. E. M. (2014). Does coaching work? A meta-analysis on the effects of coaching on individual level outcomes in an organizational context. *Journal of Positive Psychology, 9*(1), 1-18. doi:10.1080/17439760.2013.837499

Thomas, A., & Loadman, W. E. (2001). Evaluating teacher education programs using a national survey. *Journal of Educational Research, 94*(4), 195-206. doi:10.1080/00220670109598753

Timmerman, C. E., & Kruepke, K. A. (2006). Computer-assisted instruction, media richness, and college student performance. *Communication Education, 55*(1), 73-104. doi:10.1080/03634520500489666

Underhill, C. M. (2006). The effectiveness of mentoring programs in corporate settings: A meta-analytical review of the literature. *Journal of Vocational Behavior, 68*(2), 292-307.

Ungerleider, C., & Burns, T. (2003). *A systematic review of the effectiveness and efficiency of networked ICT in education.* Ottawa, Canada: Council of Ministers of Education, Canada and Industry Canada. Retrieved from http://204.225.6.243/stats/SystematicReview2003.en.pdf

Üstün, U. (2012). *To what extent is problem-based learning effective as compared to traditional teaching in science education? A meta-analysis study.* (Doctoral Dissertation), Middle East Technical University, Ankara, Turkey. Retrieved from http://etd.lib.metu.edu.tr/upload/12615106/index.pdf

Van der Kleij, F. M., Feskens, R. C. W., & Eggen, T. J. H. M. (2015). Effects of feedback on a computer-based learning environment on students' learning outcomes: A meta-analysis. *Review of Education Research, 85*(4), 475-511. doi:10.3102/0034654314564881

Vernon, D. T. A., & Blake, R. L. (1993). Does problem-based learning work? A meta-analysis of evaluative research. *Academic Medicine, 68*(7), 550-563. doi:10.1097/00001888-199307000-00015

Vo, H. M., Zhu, C., & Diep, N. A. (2017). The effect of blended learning on student performance at course-level in higher education: A meta-analysis. *Studies in Educational Evaluation, 53*, 17-28. doi:10.1016/j.stueduc.2017.01.002

Whitford, D. K., Zhang, D., & Katsiyassis, A. (2018). Traditional vs. alternative teacher preparation programs: A meta-analysis. *Journal of Child and Family Studies, 27*(3), 671-685. doi:10.1007/s10826-017-0932-0

Whittaker, S. M. (2004). *A multi-vocal synthesis of supervisees' anxiety and self-efficacy during clinical supervision: Meta-analysis and interviews.* (Doctoral Dissertation), Virginia Polytechnic Institute and State University, Blacksburg, VA.

Williams, S. L. (2004). *A meta-analysis of the effectiveness of distance education in allied health science programs.* (Doctoral Dissertation), University of Cincinnati, Cincinnati, OH.

Wittwer, J., & Renkl, A. (2010). How effective are instructional explanations in example-based learning? A meta-analytic review. *Educational Psychology Review, 22*, 393-409. doi:10.1007/s10648-010-9136-5

Yaakub, M. N. (1998). *Meta-analysis of the effectiveness of computer-assisted instruction in technical education and training.* (Doctoral Dissertation), Virginia Polytechnic Institute and State University, Blacksburg, VA. Retrieved from https://vtechworks.lib.vt.edu/bitstream/handle/10919/30651

Yang, L. (2017). Meta-analysis of the impact of service learning on students from statistical perception. *Research on Modern Higher Education, 3*, 87-89.

Yeany, R. H., & Padilla, M. J. (1986). Training science teachers to utilize better teaching strategies: A research synthesis. *Journal of Research in Science Teaching, 23*(2), 85-95. doi:10.1002/tea.3660230202

Zhao, Y. (2003). Recent Developments in technology and language learning: A literature review and meta-analysis. *CALICO Journal, 21*(1), 7-27.

Zhao, Y., Lei, J., Yan, B., Lai, C., & Tan, H. S. (2005). What makes the difference? A practical analysis of research on the effectiveness of distance education. *Teachers College Record, 107*, 1836-1884. doi:10.1111/j.1467-9620.2005.00544.x

Appendix B

Journals Searched for Meta-Analyses of Teacher Preparation Practices

AAUP Journal of Academic Freedom	Current Issues in Education
Acta Didactia Napocensia	Early Childhood Research & Practice
Action in Teacher Education	Early Education and Development
Advances in Physiological Education	
American Educational Research Journal	Education and Information Technologies
American Journal of Distance Education	Education Research International
ASEAN Journal of Teaching and Learning in Higher Education	Education, Research and Perspectives
Asian Journal of Distance Education	Educational Evaluation and Policy Analysis
Asia-Pacific Forum on Science Learning and Teaching	Educational Leadership
Asia-Pacific Journal of Teacher Education	Educational Psychology Review
Atlas Journal of Science Education	Educational Research and Reviews
Australian Journal of Educational and Developmental Psychology	Educause Review
British Medical Journal	E-international Journal of Educational Research
Brock Education: A Journal of Educational Research and Practice	E-Journal of Organizational Learning and Leadership
Canadian Journal for the Scholarship of Teaching and Learning	E-Learning and Education
Canadian Journal of Educational Administration and Policy	English Language Teaching
Canadian Journal of Higher Education	Ethiopian Journal of Education and Sciences
Canadian Journal of Learning and Technology	European Journal of Teacher Education
Canadian Journal of University Continuing Education	Field Experiences Journal
Canadian Medical Association Journal	Higher Education in Review
College Student Journal	Information & Management
CORELL: Computer Resources for Language Learning	Interdisciplinary Journal of Problem-Based Learning
Creative Education	International Electronic Journal of Elementary Education
Critical Education	International Journal for Educational Integrity
Critical Literacy: Theories and Practices	International Journal for the Scholarship of Teaching and Learning
International Journal of Applied Semiotics	Journal of Interactive Media in Education

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International Journal of Early Childhood Special Education	Journal of Mathematics Education at Teachers College
International Journal of Education Policy and Leadership	Journal of Personality and Social Psychology
International Journal of Educational Management	Journal of Personnel Evaluation in Education
International Journal of Medical Education	Journal of Physical Education, Recreation and Dance
International Journal of Mentoring and Coaching in Education	Journal of Research in Science Teaching
International Journal of Research on Service Learning and Community Engagement	Journal of Research on Technology in Education
International Journal of Special Education	Journal of Science Teacher Education
International Journal of Teaching and Learning in Higher Education	Journal of Special Education
International Review of Research in Open and Distance Learning	Journal of STEM Education
Issues in Educational Research	Journal of Teacher Education
Journal for Educational Research Online	Journal of Teacher Education for Sustainability
Journal for Research in Mathematics Education	Journal of Teaching Effectiveness
Journal of Applied Psychology	Journal of Technology Studies
Journal of Career Development	Journal of Technology and Teacher Education
Journal of Communication	Journal of the European Teacher Education Network
Journal of Computing in Higher Education	Journal of Vocational Behavior
Journal of Curriculum Studies	MERLOT Journal of Online Learning and Teaching
Journal of Distance Education	New Waves Educational Research and Development
Journal of Early Intervention	Oxford Review of Economic Policy
Journal of Education and Training Studies	Professional Development in Education
Journal of Education and Training Studies	Public Health Research
Journal of Educational Psychology	Reading and Writing
Journal of Educational Research	Reading Research Quarterly
Journal of Engineering Education	Remedial and Special Education
Journal of Higher Education Outreach and Engagement	Research in Higher Education

Appendix B, continued.

Research on Modern Higher Education	Teacher Education and Special Education
Review of Educational Research	Teacher Educator
Scholarship of Teaching and Learning in Psychology	Teachers College Record
School Community Journal	Teaching and Teacher Education
School Science and Mathematics	Teaching of Psychology
South African Journal of Childhood Education	Topics in Early Childhood Education
Studies in Science Education	Topics in Early Childhood Special Education

Appendix C-1

Meta-Analyses Included in the Metasynthesis

Studies	Source of Report[a]	Preservice Variables	Number of Studies	Sample Size	Number of Effect Sizes
Manning et al. (2017)	JA	Teacher Education	7	1334	10
Early et al. (2007)	JA	Teacher Education Teacher Certification In-Field Degree	7	2994	250
Kelley & Camilli (2007)	JA	Teacher Education	18	3922	105
Falenchuk et al. (2017)	JA	Teacher Education	3	7265	7
Greenwald et al. (1996)	JA	Teacher Education	8	-	15
Qu & Becker (2003)	CP	Teacher Certification	24	-	105
Whitford et al. (2018)	JA	Teacher Certification	12	39756	91
Hacke (2010)	DT	Teacher Certification	12	1047391	21
Druva & Anderson (1983)	JA	Coursework	-	-	3
Anderson et al. (1982)	UR	Coursework	-	-	5
Crede et al. (2010)	JA	Coursework	68	21164	68
Permzadian & Crede (2016)	JA	Coursework	284	222072	284
Jahng et al. (2007)	JA	Course Methods	20	1617	20
Shachar & Neumann (2010)	JA	Course Methods	125	20800	125
Bernard et al. (2004)	JA	Course Methods	-	-	219
Roberts (2011)	DT	Course Methods	59	4350	86
Allen, M. et al. (2002)	JA	Course Methods	17	3571	20
Allen, M. et al. (2004)	JA	Course Methods	28	71731	39
Zhao et al. (2005)	JA	Course Methods	-	-	36
Williams (2004)	DT	Course Methods	25	1322	48
Means et al. (2013)	JA	Course Methods	21	-	31
Bernard et al. (2014)	JA	Course Methods	96	10800	117
Sitzmann et al. (2006)	JA	Course Methods	96	19331	155

[a]JA = Journal article, DT = Dissertation or thesis, CP = Conference presentation, and UR = Unpublished report.

Appendix C-1, continued.

Studies	Source of Report[a]	Preservice Variables	Number of Studies	Sample Size	Number of Effect Sizes
Vo et al. (2017)	JA	Course Methods	40	7033	51
Aiello & Wolfe (1980)	CP	Course Methods	-	-	100
Kulik et al. (1979a)	JA	Course Methods	75	-	93
Kulik, Cohen & Ebeling (1980)	JA	Course Methods	56	-	56
Kulik et al. (1979b)	JA	Course Methods	42	-	70
Yaakub (1998)	DT	E-Learning	8	726	14
Schmid et al. (2014)	JA	E-Learning	-	-	581
Kulik & Kulik (1991)	JA	E-Learning	-	-	149
Michko (2008)	CP	E-Learning	45	11700	123
Schmid et al. (2009)	JA	E-Learning	231	25497	310
Ungerleider & Burns (2003)	UR	E-Learning	8	960	16
Zhao (2003)	JA	E-Learning	9	419	9
Castillo-Manzano et al. (2016)	JA	E-Learning	28	14629	46
Mothibi (2015)	JA	E-Learning	15	-	15
Steenbergen & Cooper (2014)	JA	E-Learning	37	-	37
Koufogiannakis & Wiebe (2006)	JA	E-Learning	8	796	8
Bayraktar (2002)	JA	E-Learning	21	-	55
Kulik, Kulik & Cohen (1980)	JA	E-Learning	11	-	18
Sosa et al. (2011)	JA	E-Learning	45	9639	45
Hsu (2003)	DT	E-Learning	25	3419	31
Schenker (2007)	DT	E-Learning	46	9757	204
Timmerman & Kruepke (2006)	JA	E-Learning	118	12398	118
Camnalbur & Erdogan (2008)	JA	E-Learning	78	5096	77
Fletcher-Flinn & Gravatt (1995)	JA	E-Learning	48	-	48
Lou et al. (2001)	JA	E-Learning	51	-	164
Azevedo & Bernard (1995)	CP	E-Learning	11	341	17

[a]JA = Journal article, DT = Dissertation or thesis, CP = Conference presentation, and UR = Unpublished report.

Appendix C-1, continued.

Studies	Source of Report[a]	Preservice Variables	Number of Studies	Sample Size	Number of Effect Sizes
Van der Kleij et al. (2015)	JA	E-Learning	53	-	53
Karich et al. (2014)	JA	E-Learning	9	-	14
Parsons (1991)	DT	E-Learning	24	2420	50
Cook et al. (2010)	JA	E-Learning	-	-	74
Merchant et al. (2014)	JA	E-Learning	67	8432	67
Leary (2012)	DT	Learning Methods	38	13899	75
Leary et al. (2013)	JA	Learning Methods	-	18979	146
Dochy et al. (2003); Gijbels et al. (2005)	JA	Learning Methods	25	5155	49
Ustun (2012)	DT	Learning Methods	45	-	70
Schmidt et al. (2009)	JA	Learning Methods	18	40083	61
Vernon & Blake (1993)	JA	Learning Methods	19	4009	52
Jurewitsch (2012)	JA	Learning Methods	5	518	5
Dunst et al. (2010)	JA	Learning Methods	22	1980	30
Freeman et al. (2014)	JA	Learning Methods	158	-	158
Murad et al. (2010)	JA	Learning Methods	6	-	6
Benz (2010)	DT	Learning Methods	-	830	16
Alfieri et al. (2011)	JA	Learning Methods	52	3104	63
Sweitzer & Anderson (1983)	JA	Learning Methods	-	-	122
Yeany & Padilla (1986)	JA	Learning Methods	-	-	24
Ayaz & Soylemez (2015)	JA	Learning Methods	9	-	9
Wittwer & Renkl (2010)	JA	Learning Methods	21	-	57
Cohen et al. (1981)	JA	Learning Methods	74	-	93
Henk & Stahl (1985)	CP	Learning Methods	14	-	25
Kobayashi (2005)	JA	Learning Methods	-	-	97
Larwin & Larwin (2013)	JA	Learning Methods	-	-	12

[a]JA = Journal article, DT = Dissertation or thesis, CP = Conference presentation, and UR = Unpublished report.

Appendix C-1, continued.

Studies	Source of Report[a]	Preservice Variables	Number of Studies	Sample Size	Number of Effect Sizes
Larwin et al. (2013)	JA	Learning Methods	15	1348	35
Abrami et al. (2015)	JA	Learning Methods	-	-	126
Springer et al. (1999)	JA	Cooperative Learning	31	2559	44
Kalaian & Kasim (2014)	JA	Cooperative Learning	9	926	10
Huddy (2012)	DT	Cooperative Learning	20	1930	32
Caper & Tarim (2015)	JA	Cooperative Learning	4	-	5
Lou et al. (1996)	JA	Cooperative Learning	-	-	7
Bowen (2000)	JA	Cooperative Learning	11	1537	30
Liu & Beaujean (2017)	JA	Cooperative Learning	10	-	10
Pai et al. (2015)	JA	Cooperative Learning	24	3106	38
Johnson et al. (1981)	JA	Cooperative Learning	-	-	104
Leung (2015)	JA	Cooperative Learning	9	-	9
Alegre-Ansuategui et al. (2018)	JA	Cooperative Learning	4	1397	4
Rees et al. (2016)	JA	Cooperative Learning	10	1300	20
Balta et al. (2017)	JA	Cooperative Learning	16	2050	16
Penny & Coe (2004)	JA	Faculty Practices	11	331	11
Fukkink et al. (2011)	JA	Faculty Practices	33	1058	217
Menges & Brinko (1986)	CP	Faculty Practices	30	-	40
Cohen (1980)	JA	Faculty Practices	17	-	22
Eby et al. (2008)	JA	Faculty Practices	23	3570	25
Sneyers & Witte (2018)	JA	Faculty Practices	9	20991	9
Bangert-Drowns et al. (1991)	JA	Faculty Practices	28	2460	42
Kulik & Kulik (1988)	JA	Faculty Practices	10	-	18
Gliessman et al. (1988)	JA	Teaching Instruction	26	-	26
Metcalf (1995)	CP	Teaching Instruction	36	1944	58
Butcher (1981)	DT	Teaching Instruction	47	-	47

[a]JA = Journal article, DT = Dissertation or thesis, CP = Conference presentation, and UR = Unpublished report.

Appendix C-1, continued.

Studies	Source of Report[a]	Preservice Variables	Number of Studies	Sample Size	Number of Effect Sizes
Baker & Daniels (1989)	JA	Teaching Instruction	52	-	52
Cook et al. (2013)	JA	Teaching Instruction	171	9937	190
Kim et al. (2016)	JA	Teaching Instruction	40	2924	40
McGaghie et al. (2011)	JA	Teaching Instruction	10	-	10
Liu & Chang (2017)	JA	Teaching Instruction	11	745	11
Niu et al. (2013)	JA	Teaching Instruction	31	-	40
Malone (1984)	CP	Field Experiences	-	-	74
Yang (2017)	JA	Field Experiences	62	-	121
Novak et al. (2007)	JA	Field Experiences	9	1610	9
Hatala et al. (2013)	JA	Clinical Supervision	17	653	17
Kluger & DeNisi (1996)	JA	Clinical Supervision	131	12652	607
Whittaker (2004)	DT	Clinical Supervision	8	293	12
Kraft et al. (2018)	JA	Induction/Mentoring	55	-	299
Underhill (2006)	JA	Induction/Mentoring	14	5449	88
Allen, T. et al. (2004)	JA	Induction/Mentoring	-	3029+	27
Jones et al. (2016)	JA	Induction/Mentoring	14	2109	14
Theeboom et al. (2014)	JA	Induction/Mentoring	18	2090	24

[a]JA = Journal article, DT = Dissertation or thesis, CP = Conference presentation, and UR = Unpublished report.

Appendix C-2

Surveys Included in the Metasynthesis

Studies	Source of Report[a]	Variables	Sample Size	Number of Effect Sizes
Gong (2015)	DT	Teacher Education	4300	7
Andrew & Schwab (1995); Baker & Andrew (1993);	JA, CP	Teacher Preparation Program	1394	21
Thomas & Loadman (2001)	JA	Teacher Preparation Program	3875	4
Latham et al. (2015)	JA	Teacher Preparation Program	6649	1
Sparks (2004)	DT	In-Field Certification or Degree	613	2
Ronfeldt et al. (2014)	JA	Coursework	3145	6
Monk (1994)	JA	Coursework	1492	6
Boe et al. (2007)	JA	Field Experience	10952	16
Duke et al. (2006)	JA	Induction and Mentoring	4952	2
Ingvarson et al. (2007)	JA	Induction and Mentoring	1147	4
Smith & Ingersoll (2004)	JA	Induction and Mentoring	3235	9
DeAngelis et al. (2013)	JA	Induction and Mentoring	1159	16

[a]JA = Journal article, DT = Dissertation or thesis, and CP = Conference presentation.

Appendix D

Types of Research Designs Used in the Meta-Analyses and Surveys

Study	Type of Study[a]	Type of Research Design	Comparison
Abrami et al. (2015)	MA	Between group comparison	Post-test differences
Aiello & Wolfe (1980)	MA	Between group comparison	Post-test differences
Alegre-Ansuategui et al. (2018)	MA	Between group comparison	Pretest-posttest difference scores
Alfieri et al. (2011)	MA	Between group comparison	Post-test differences
Allen, M. et al. (2002)	MA	Between group comparison	Post-test differences
Allen, M. et al. (2004)	MA	Between group comparison	Post-test differences
Allen, T. et al. (2004)	MA	Between group comparison	Post-test differences
Anderson et al. (1982)	MA	Between group comparison	Post-test differences
Andrew & Schwab (1995); Baker & Andrew (1993);	NS	Between group comparison	Post-test differences
Ayaz & Soylemez (2015)	MA	Between group comparison	Post-test differences
Azevedo & Bernard (1995)		Between group comparison	Post-test differences
Baker & Daniels (1989)	MA	Between group comparison	Post-test differences
Balta et al. (2017)	MA	Between group comparison	Pretest-posttest differences
Bangert-Drowns et al. (1991)	MA	Between group comparison	Post-test differences
Bayraktar (2002)	MA	Between group comparison	Post-test differences
Benz (2010)	MA	Between group comparison	Post-test differences
Bernard et al. (2004)	MA	Between group comparison	Post-test differences
Bernard et al. (2014)	MA	Between group comparison	Post-test differences
Boe et al. (2007)	NS	Between group comparison	Post-test differences
Borman & Dowling (2008)	MA	Between group comparison	Post-test differences
Bowen (2000)	MA	Between group comparison	Post-test differences
Butcher (1981)	MA	Between group comparison	Pretest-Posttest difference scores
Camnalbur & Erdogan (2008)	MA	Between group comparison	Post-test differences
Capar & Tarim (2015)	MA	Between group comparison	Post-test differences (NR) Pre-post difference scores (NR)

[a]MA = Meta-analysis, NS = National or large sample size study, and NR = Not reported.

Appendix D, continued.

Study	Type of Study[a]	Type of Research Design	Comparison
Castillo-Manzano et al. (2016)	MA	Between group comparison	Post-test differences
Cohen (1980)	MA	Between group comparison	Post-test differences
Cohen et al. (1981)	MA	Between group comparison	Post-test differences
Cook et al. (2013)	MA	Between group comparison	Post-test differences
Cook et al. (2010)	MA	Between group comparison	Post-test differences (56%) Pretest-posttest differences (44%)
Crede et al. (2010)	MA	Correlational analysis	Class attendance
DeAngelis et al. (2013)	NS	Between group comparison	Post-test differences
Dochy et al. (2003); Gijbels et al. (2005)	MA	Between group comparison	Post-test differences
Druva & Anderson (1983)	MA	Between group comparison	Post-test differences
Duke et al. (2006)	NS	Between group comparison	Post-test differences
Dunst et al. (2010)	MA	Between group comparison	Post-test differences
Early et al. (2007)	MS	Between group comparison	Post-test differences
Eby et al. (2008)	MA	Between group comparison	Post-test differences
Falenchuk et al. (2017)	MA	Between group comparison	Post-test differences
Fletcher-Flinn & Gravatt (1995)	MA	Between group comparison	Post-test differences
Freeman et al. (2014)	MA	Between group comparison	Post-test differences
Fukkink et al. (2011)	MA	Between group comparison	Post-test differences
Gliessman et al. (1988)	MA	Between group comparison	Post-test differences
Gong (2015)	NS	Between group comparison	Post-test differences
Greenwald et al. (1996)	MA	Between group comparison	Post-test differences
Hacke (2010)	MA	Between group comparison	Post-test differences
Hatala et al. (2013)	MA	Between group comparison	Post-test differences
Henk & Stahl (1985)	MA	Between group comparison	Post-test differences
Hsu (2003)	MA	Between group comparison	Post-test differences

Appendix D, continued.

Study	Type of Study[a]	Type of Research Design	Comparison
Huddy (2012)	MA	Between group comparison	Post-test differences
Ingvarson et al. (2007)	NS	Between group comparison	Post-test differences
Jahng et al. (2007)	MA	Between group comparison	Post-test differences
Johnson et al. (1981)	MA	Between group comparison	Post-test differences
Jones et al. (2016)	MA	Between group comparison	Post-test differences
Jurewitsch (2012)	MA	Between group comparison	Post-test differences
Kalaian & Kasim (2014)	MA	Between group comparison	Post-test differences
Karich et al. (2014)	MA	Between group comparison	Post-test differences
Kelley & Camilli (2007)	MA	Between group comparison	Pretest-posttest difference scores
Kim et al. (2016)	MA	Between group comparison	Post-test differences
Kluger & DeNisi (1996)	MA	Between group comparison	Post-test differences
Kobayashi (2005)	MA	Between group comparison	Post-test differences
Koufogiannakis & Wiebe (2006)	MA	Between group comparison	Post-test differences
Kraft et al. (2018)	MA	Between group comparison	Post-test differences
Kulik & Kulik (1988)	MA	Between group comparison	Post-test differences
Kulik & Kulik (1991)	MA	Between group comparison	Post-test differences
Kulik et al. (1979a)	MA	Between group comparison	Post-test differences
Kulik et al. (1979b)	MA	Between group comparison	Post-test differences
Kulik, Cohen & Ebeling (1980)	MA	Between group comparison	Post-test differences
Kulik, Kulik & Cohen (1980)	MA	Between group comparison	Post-test differences
Larwin et al. (2013)	MA	Between group comparison	Post-test differences
Larwin & Larwin (2013)	MA	Between group comparison Pre-post intervention	Post-test differences (48%) Pretest-posttest difference scores (52%)
Latham et al. (2015)	NS	Between group comparison	Post-test differences
Leary (2012)	MA	Between group comparison	Post-test differences
Leary et al. (2013)	MA	Between group comparison	Post-test differences

Appendix D, continued.

Study	Type of Study[a]	Type of Research Design	Comparison
Leung (2015)	MA	Between group comparison	Post-test differences
Liu & Chang (2017)	MA	Between group comparison	Post-test differences
Liu & Beaujean (2017)	MA	Between group comparison	Post-test differences
Lou et al. (2001)	MA	Between group comparison	Post-test differences
Lou et al. (1996)	MA	Between group comparison	Post-test differences
Malone (1984)	MA	Between group comparison	Post-test differences
Manning et al. (2017)	MA	Between group comparison	Post-test differences
McGaghie et al. (2011)	MA	Between group comparison	Post-test differences
Means et al. (2013)	MA	Between group comparison	Post-test differences
Menges & Brinko (1986)	MA	Between group comparison	Post-test differences
Merchant et al. (2014)	MA	Between group comparison	Post-test differences
Metcalf (1995)	MA	Between group comparison	Post-test differences
Michko (2008)	MA	Between group comparison	Post-test differences
Monk (1994)	NS	Correlational analysis	Regressions
Mothibi (2015)	MA	Between group comparison	Post-test differences
Murad et al. (2010)	MA	Between group comparison	Post-test differences (NR) Pretest-posttest differences (NR)
Niu et al. (2013)	MA	Between group comparison Pre-post intervention	Post-test differences (58%) Pretest-posttest difference scores (42%)
Novak et al. (2007)	MA	Between group comparison	Post-test differences
Pai et al. (2015)	MA	Between group comparison	Post-test differences
Parsons (1991)	MA	Between group comparison	Post-test differences
Penny & Coe (2004)	MA	Between group comparison	Post-test differences
Permzadian & Crede (2016)	MA	Between group comparison	Post-test differences
Qu & Becker (2003)	MA	Between group comparison	Post-test differences
Rees et al. (2016)	MA	Between group comparison	Post-test differences
Roberts (2011)	MA	Between group comparison	Post-test differences (NR) Pretest-posttest difference (NR)

Appendix D, continued.

Study	Type of Study[a]	Type of Research Design	Comparison
Ronfeldt et al (2014)	NS	Correlational analysis	Number of courses
Schenker (2007)	MA	Between group comparison	Post-test differences
Schmid et al. (2009)	MA	Between group comparison and Pre-post intervention	Post-test differences (NR) Pretest-posttest difference (NR)
Schmid et al. (2014)	MA	Between group comparison	Post-test differences (NR) Pretest-posttest difference (NR)
Schmidt et al. (2009)	MA	Between group comparison	Post-test differences
Shachar & Neumann (2010)	MA	Between group comparison	Post-test differences
Sitzmann et al. (2006)	MA	Between group comparison	Post-test differences
Smith & Ingersoll (2004)		Between group comparison	Post-test differences
Sneyers & Witte (2018)	MA	Between group comparison	Post-test differences
Sosa et al. (2011)	MA	Between group comparison	Post-test differences
Sparks (2004)	NS	Between group comparison	Pretest-posttest difference scores
Springer et al. (1999)	MA	Between group comparison	Post-test differences
Steenbergen & Cooper (2014)	MA	Between group comparison	Post-test differences
Sweitzer & Anderson (1983)	MA	Between group comparison Pre-post intervention	Post-test differences (86%) Pretest-posttest differences (14%)
Theeboom et al. (2014)	MA	Between group comparison	Post-test differences
Thomas & Loadman (2001)	NS	Between group comparison	Post-test differences
Timmerman & Kruepke (2006)	MA	Between group comparison	Post-test differences
Underhill (2006)	MA	Between group comparison	Post-test differences
Ungerleider & Burns (2003)	MA	Between group comparison	Post-test differences
Ustun (2012)	MA	Between group comparison	Post-test differences
Van der Kleij et al. (2015)	MA	Between group comparison	Post-test differences
Vernon & Blake (1993)	MA	Between group comparison	Post-test differences

[a]MA = Meta-analysis and NS = National or large sample size study.

Appendix D, continued.

Study	Type of Study[a]	Type of Research Design	Comparison
Vo et al. (2017)	MA	Between group comparison	Post-test differences (NR) Pretest-posttest difference (NR)
Whitford et al. (2018)	MA	Between group comparison	Post-test differences
Whittaker (2004)	MA	Between group comparison	Post-test differences
Williams (2004)	MA	Between group comparison	Post-test differences
Wittwer & Renkl (2010)	MA	Between group comparison	Post-test differences
Yaakub (1998)	MA	Between group comparison Pre-post intervention comparison	Post-test differences (NR) Pretest-posttest difference (NR)
Yang (2017)	MA	Between group comparison	Post-test differences Pretest-posttest difference
Yeany & Padilla (1986)	MA	Between group comparison	Post-test differences
Zhao (2003)	MA	Between group comparison	Post-test differences
Zhao et al. (2005)	MA	Between group comparison	Post-test differences

Appendix E

Definitions of Teacher Preparation Practices

Type of Teacher Degree

HS (High School): Completed 12 years of formal education or equivalent (e.g., GED)

AA (Associate's Degree): Completed two years of post-high school education with a specialty in education or a related field.

CDA (Child Development Associate Credential): Completed the requirements for a Credential in Early Childhood Education.

BA (Bachelor's Degree): Completed four years of post-high school education at the college or university level.

BA+ (Bachelor's Degree plus additional education): Completed four years of post-high school education at the college or university level plus additional education.

MA (Master's Degree): Completed one or two years of formal education beyond a bachelor's degree at the college or university level leading to a master's degree.

Type of Teacher Preparation Program

4 Year Degree Program: Completed a formal 4-year undergraduate degree program in education or special education at the college or university level.

5 Year Degree Program: Completed a formal 5-year undergraduate-master's degree program in education or special education at the college or university level.

BA (Baccalaureate Degree Program): Completed a traditional undergraduate degree teacher preparation program.

EP (Extended Degree Program): Completed an extended teacher preparation program including a master's degree program.

Type of Teacher Certification

TC (Traditional or Standard Teacher Certification): Requires a "bachelor's degree in education [and must have completed] student teaching under the direction of a supervisor or master/mentor teacher" (Qu & Becker, 2003, p. 4).

NBC (National Board Teacher Certification): Requires a bachelors degree in education and must meet standards-based competencies in content knowledge, instruction, teaching practices, learning environments, and reflective practice (National Board for Professional Teaching Standards, 2018).

TAC (Teach for America Teacher Certification): Requires a bachelor's degree, a minimum cumulative GPA, legal status, education coursework, attendance at an intensive summer training program, attendance at a five to seven week residential institute, and two years of Teach for America mentored teaching (Teach for America, 2018).

AC (Alternative Teacher Certification): Requires a bachelor's degree in a subject-matter field and completion of a teacher preparation program while teaching full-time (Qu & Becker, 2003; Whitford, Zhang, & Katsiyassis, 2018).

EC (Emergency or Temporary Teacher Certification): Requires a bachelor's degree and some training before teaching, school district mentoring and support during initial teaching, and enrollment in a traditional or standard teacher certification program.

PC (Probationary or Provisional Teacher Certification): Requires a bachelor's degree where candidates have not satisfied all the requirements for teacher certification where the probationary certification is generally valid for one year.

OTC (Other Nonspecified Teacher Certification): Meets all the requirements for a traditional or standard teacher certification in a nonspecified field.

NC (Not Certified): Teachers who possess no type of teacher certification.

In-Field Certification or Degree

IFC (In-Field Teacher Certification or Degree): Holds a teaching degree in a particular field of study and is teaching in that field.

ECE (Early Childhood Education Degree): Holds a teaching degree in early childhood education and is teaching in an early childhood program or at the preschool level.

OFC (Out-of-field Teacher Certification or Degree): Holds a teaching degree in a particular field of study but is teaching in another education or special education field.

EC (Emergency or Temporary Teacher Certification): Requires a bachelors degree and some training before teaching, school district mentoring and support during initial teaching, and enrollment in a traditional or standard teacher certification program.

PC (Probationary or Provisional Teacher Certification): Requires a bachelor's degree but candidates have not satisfied all the requirements for teacher certification where the probationary certification is generally valid for one year.

OTC (Other Nonspecified Teacher Certification): Meets all the requirements for a traditional or standard teacher certification in a nonspecified field.

Coursework Measures

GEC (General Education Courses): Foundational courses in education designed to promote student understanding of the teaching profession and the knowledge and skills needed to be an effective teacher.

MC (Methods Courses): Courses focusing specifically on promoting a student's ability to use teaching methods, instructional practices, and classroom organization and management practices in particular subject areas or grade levels.

SC (Science Education Courses): Courses designed to promote a student's understanding of a particular area of science and the ability to provide instruction in that area.

FYS (First Year Seminars): First year university or college seminar to prepare and support their transitions to higher education.

CA (Class Attendance): Number of classes attended by students in a specific university class.

NSS (No Student Seminars): Students who were not offered or attended first year student seminars.

Methods of Course Delivery

DEC (Distance Education Course): Course delivered via the Internet, one way or two-way transmission, audioconferencing, DVDs or CD-ROMs, or other technologies not including any face-to-face student-instructor interactions.

DEC(F) (Distance Education Course Fully Interactive): Distance education courses that include real-time interactions with instructors or peers not including any face-to-face student-instruction interactions.

DEC(L) (Distance Education Course Limited Interactive): Distance education courses that do not include any face-to-face student-instructor interactions but include different opportunities for students to seek instructor input online via message boards, email, and other means.

DEC(S) (Distance Education Course Synchronous): Distance education courses that include real-time interactions with an instructor in a manner identical to fully interactive distance education courses.

DEC(A) (Distance Education Course Asynchronous): Distance education courses where instructors and students interact with one another in different locations and at different times in a manner similar to limited or partially interactive distance education courses.

BLC (Blended Learning Course): Combined use of traditional classroom instruction and some type of technology-assisted on-line learning occurring outside of a university classroom setting.

PDI (Personalized System of Instruction Courses): Self-paced, student proctored courses that employ study guides to promote student mastery of course content. In some cases, occasional traditional classroom instruction is used to motivate students or reinforce self-paced learning.

ATI (Audio-Tutorial Instruction Courses): University courses that include independent study sessions were audiotapes and other media are used to promote student mastery of course content where more traditional classroom practices (e.g., interactive lectures) are used to reinforce self-guided instruction.

TCI (Traditional Classroom Instruction): Traditional classroom lecture, other types of face-to-face instruction, or business-as-usual.

Technology-Based and E-Learning Instruction

TAI (Technology-Assisted Instruction): Use of a "broad variety of modalities, tools, and strategie[to facilitate student] learning...including computer-based tools and applications (Schmid et al., 2014, p. 273).

ICT (Information and Communication Technology Learning): The use of any number of technologies (web-based, e-learning, and wireless tools and telecommunication devices, etc.) to facilitate student learning.

ITS (Intelligent Tutoring System Learning): "Computer-assisted learning environments [that] are highly adaptive, interactive, and learner [self]-paced" (Steenbergen-Hu & Cooper, 2014).

CAI (Computer-Assisted Instruction): Computer-based activities used to either replace or supplement traditional classroom instruction.

CAI(SG) (Small Group Computer Assisted Instruction): Computer-assisted instruction where a small group of students work together on the same problem or learning content.

CAI(I) (Individual Student Computer Assisted Instruction): Computer-assisted instruction when a student worked alone on mastering learning content or solving a problem.

CAI(FB) (Computer Assisted Instruction with Feedback): Computer-assisted instruction that included computer delivered feedback following student responses to student learning.

CAI(NF) (Computer Assisted Instruction with No Feedback): Computer-assisted instruction that involved no computer delivered feedback in response to student learning.

CAI(LC) (Computer Assisted Instruction with Learner Control): Computer-assisted instruction that involved student control over their learning experiences.

CAI(NC) (Computer Assisted Instruction with no Learner Control): Computer-assisted instruction that involved no student control over their learning experiences.

WBI (Web-Based Instruction): Instruction delivered via the Internet in a manner that is "hypermedia based which utilizes the attributes and resources of the World Wide Web to create a meaningful learning environment where learning is fostered and supported" (Khan, 1997, p. 6).

IBI (Internet-Based Instruction): Instruction delivered via the Internet in a manner similar to web-based instruction.

VRI (Virtual Reality-Based Instruction): VRI (Virtual Reality-Based Instruction): Instructional method that uses interactive virtual reality games, simulations, virtual worlds, and other similar digital learning environments to imitate or model real-life processes and learning situations (Merchant et al., 2014).

Course-Based Student Learning

PBL (Problem-Based Learning): Teaching method where complex, real-world (authentic) ill-structured problems are used to promote small group, student-centered learning where coaches, mentors, or tutors act as facilitators (Barrows, 1996).

PBL(O) (Problem-Based Learning Online): Learning activities that involve problem-based learning involving real-world problems delivered online in small groups rather than face-to-face.

GD (Guided Design): Instructional method characterized by a decision-making and problem solving process that uses real-world (authentic) problems for mastering learning content in the context of small-group learning and instructor/facilitator guidance and feedback (Wales & Stager, 1978). Guided design is a particular type of problem-based learning practice.

ASL (Active Student Learning): Traditional course-based learning that include activities, exercises, and a variety of methods that involved "group problem-solving, worksheets or tutorials completed during class, use of personal response systems with or without peer instruction, and studio or workshop course designs" (Freeman et al., 2014, p. 8410)

SDL (Student Self-Directed Learning): Self-guided or self-regulated student learning interventions that are used to actively engage students in knowledge acquisition where instructors facilitate rather than direct learning.

DL (Discovery Learning Practices): Discovery-based learning that involves "an opportunity to provide the learners with intensive or, conversely, minimal guidance, where both types can take many forms (e.g., manuals, simulations, feedback, example problems)" (Alfieri et al., 2011, p. 2).

IBL (Inquiry-Based Learning Practices): A particular form of active student learning that involves questions, problems, or scenarios posed by an instructor to facilitate student knowledge acquisition or skill development or both.

PJL (Project-Based Learning Practices): A particular type of practice that engages students in learning activities around projects or complex tasks that focus on answering specific questions or mastering concepts where learning is facilitated by an instructor.

EBL (Explanation-Based Learning): Instruction where "learners first receive a general description of concepts and principles of a domain to be learned. Second, learners study worked examples that are an instance of these concepts and principles. The worked examples normally consist of three components presented to the learners: (1) the formulation of definite problem (e.g., a combination problem), (2) the solution steps undertaken (i.e., operators; these steps are sometimes missing), and (3) the final solution itself (i.e., the goal). Third, in addition to studying worked examples, learners are often required to solve problems in the learning phase" (Wittwer & Renkl, 2010, pp. 393-394).

VBI (Visually-Based Instruction): Instructional method that either supplements or is a substitute for traditional classroom instruction that uses film, multi-media presentations, educational television, video, and other technology to present or illustrate course content (Cohen, Ebeling, & Kulik, 1981).

CTI (Critical Thinking Instruction): Instructional method that incorporates different elements of critical thinking (interpretation, analysis, evaluation, inferences, explanation, self-reflection) into authentic learning activities to facilitate and improve student thinking skills and knowledge acquisition (Abrami et al., 2015).

NTP (Note-Taking Practice): Instructional intervention where students were explicitly instructed to take notes as part of a traditional classroom lecture or instruction.

GNT (Guided Note Taking): "Teacher-prepared handouts that 'guide a student through a lecture with standard cues and prepared space in which to write key facts, concepts, and/or' relationships" (Heward, 1994, P. 304).

NTA (Note Taking Aides): Includes the use of student-prepared test notes, or crib sheets, as well as the use of text books for open-textbook testing conditions" (Larwin & Larwin, 2013).

LOP (Listening Only Practice): Instructional intervention where students were instructed to only listen during a traditional classroom lecture and were also instructed not to take notes.

Cooperative Learning Practices

SGL (Small Group Learning): Instructional method that involves between 2 and 10 students working together, cooperatively, to achieve specified goals or outcomes inside or outside a university classroom setting (Johnson & Johnson, 1999).

SGI (Small Group Instruction): A type of group-based learning where small groups of students are provided pre-class activities, exercises, or problems that become the focus of small group instruction during course class time.

PT (Peer Tutoring Practices): Instruction that involves "people in similar social groups, who are not professors, helping others to learn, and themselves learning by teaching (Alegre-Ansuategui, Moliner, Lorenzo, & Maroto, 2018, p. 337).

PI (Peer Instruction of Students): Involves instruction of students by another more senior level student that is a substitute for faculty instruction and which is expected to benefit both the learners and tutor (instructor).

PI + TCI (Peer Instruction + Traditional Classroom Instruction): Use of peer instruction as part of traditional classroom lectures to actively engage students in immediate application of course material.

Types of Faculty Instructional Practices

CFB (Consultative Feedback): Consultation provided to a faculty member in response to student feedback on faculty member classroom instruction.

FC (Faculty Coaching of Students): Faculty member practices used to provide support, guidance, and encouragement to a student or small group of students to improve knowledge acquisition or skill development.

SFB (Student Feedback on Instructor Practices): Student ratings of faculty or instructor teaching provided as feedback to improve faculty or instructor practices.

IVF (Video Feedback on Faculty Performance): Feedback provided to faculty from videos of faculty-student interactions designed specifically to improve faculty instructional and interactional practices.

ISI (Individualized Student Instruction):Includes any number of instructional practices that involve individualized student engagement in self-guided learning activities (study guides, written information, etc.) provided by a course instructor in various types of written formats (Aiello & Wolfle, 1980).

JIT (Just-in-Time Training): Individualized, tailored instruction provided in response to a student's request for assistance or in response to an instructor's assessment of a student's performance that typically includes faculty coaching.

FM (Faculty Mentoring): Faculty member relationship with a student that entails ongoing support, information, and guidance.

FFB (Faculty Feedback on Student Performance): Feedback provided to students by a faculty member or instructor in response to student performance.

Teaching Method Instruction

TPI (Teaching Practices Instruction): The use of different kinds of training methods and instructional practices explicitly used to promote students' acquisition of teaching skills including, but not limited to, instructor questioning and related practices.

MCT (Microteaching): Instructional practice that breaks down teaching methods into component elements or teaching skills where students have multiple opportunities to use each element or skill followed by instructor or faculty feedback.

MCC (Microcounseling): Instructional practice that involve teaching specific skills, modeling desired and expected practices, and student engagement in use of the practices with feedback in either real-life or simulated situations.

MNC (Minicourses): An extended form of microteaching that is either self-directed or peer facilitated learning activities or exercised that are designed to develop teaching skills. "Participants read detailed descriptions and definitions of the behaviors; view videotape recordings or read transcripts that demonstrate the behaviors; and complete written excerises which require recognition or generation of example and non-examples. Then, they are involved in preparing and presenting several videotaped lessons, and receive feedback on their ability to use the module behavior" (Metcalf, 1995, April, p. 14).

SBI (Simulation-Based Instruction): An instructional technique used to mirror real-life teaching or instructional experiences with guided assistance and feedback by a member or instructor in a fully interactive manner.

SBI(DP): (Simulation-Based Instruction with Deliberate Practice): The use of SBI and the explicit inclusion of deliberate practice exercises to reinforce SBI instruction.

PTO (Peer-Facilitated Teaching Opportunities): Instructional activity that involves a student trained to use a teaching method or instructional practice working with other students or teacher trainees to use a teaching method and to engage in discussion of and reflection on the use of the teaching method or instructional practice.

MOT (Video or In-Vivo Modeling of Teaching Methods): The use of videotaped observations of students using teaching methods or instructional practices followed by discussions, feedback, and reflections on the use of the methods or practices while observing the videos or reviewing use of the teaching methods.

CTI (Critical Thinking Instruction): Instructional practice used to promote students use of teaching methods that focus specifically on learners' use of creative thinking strategies as part of knowledge acquisition or skill development.

Types of Field Experiences

EST (Extensive Student Teaching): Ten or more weeks of student (practice) teaching together with completion of a combination of methods courses, field experiences, supervision, and mentorship.

LST (Limited Student Teaching): Five to nine weeks of student (practice) teaching together with at least 2 or 3 of the following: methods courses, field experiences, supervision, or mentorship.

CFE (Course-Related Field Experience): Field experience associated with any type of teacher preparation course.

FE(GE) General Education Course Field Experience): Field experience associated with a general education course.

FE(MC) Methods Courses Field Experience): Field experience associated with a preservice teacher preparation methods course.

FE(SC) (Field Experience Methods Course): Field experience associated with a science methods course.

SL (Service Learning): "A teaching and learning strategy that attempts to integrate community service [learning] with an academic curriculum, program or course" (Yang, 2017, p. 87).

NST (No Student Teaching): Little or no student (practice) teaching but completion of 2 or 3 of the following: Methods courses, field experiences, supervision, or mentorship.

NFE or NSL (No Methods Courses or No Service Learning): Students who engaged in no field experiences or service learning as part of their teacher preparation programs or any teacher preparation courses.

Clinical Supervision and Related Practices

CS (Clinical Supervision): Supervision of a practicum, student teaching, or another type of preservice preparation experience by a field supervisor or another senior level professional that includes guidance and feedback to improve student clinical or teaching skills.

FB (Feedback on Student Performance): Performance feedback provided to a student by an instructor, field supervisor, peer, or another person in the context of a student's use of some type of clinical or teaching practice as part of student teaching or other field experience.

NFB or NCS (No Student Feedback or NO Clinical Supervision): Any type of clinical or field experience that includes no type of feedback or supervision.

Induction and Mentoring

SBI (School Based Induction): Formal types of beginning teacher programs that "include opportunities for [seasoned and beginning teachers] to learn together in a supportive environment [that includes] time for collaboration, reflection and acculturation into the profession of teaching (Howe, 2006, p. 287). These programs typically include all or a combination of mentoring, internship programs, reduced teaching load, and inservice training opportunities.

GI(S) (Group Induction Seminars): Small teacher supported group networks used as a type of induction practice.

GI(C): Group Induction Collaborative Planning): Collaborative planning between experienced and beginning teachers as a type of instructor practice.

GI(I): Group Induction Interpersonal Teacher Communication): Interpersonal interactions between experienced and beginning teachers as a type of induction practice.

SBM (School Based Mentoring): Formalized mentoring of a beginning teacher by an experienced teacher or other school professional as part of the acculturation of the beginning teacher to the teaching profession.

WBM (Workplace Mentoring): A formal or informal relationship between a new, younger employee and an older, more experienced employee who helps the new employee learn to navigate the work environment through supportive guidance and feedback.

WBC (Workplace Coaching): A formal arrangement where a seasoned employee or professional coach enters into a relationship with a new or novice employee where the coach provides support, guidance, and performance feedback as a means to improve employee behavior and practices.