

# Mapping and analysing reviews of research on teaching, 1980–2018, in Web of Science: An overview of a second-order research topography

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A third level of educational research is emerging, in addition to original research and secondary-level reviews. Whereas most third-level research syntheses focus on rather restricted topical areas, this study introduces a comparative and integrative overview of prominent second-order research on teaching, including many different types of reviews and aspects of teaching. The purpose of the study is to illuminate patterns in a second-order research topography in the widespread and multifaceted field of research on teaching from 1980 to the present, in order to discuss its implications for research and review-making. The overview encompasses 75 most-cited reviews of research on teaching published in international, refereed journals from 1980 to 2018 in the Web of Science. The overview utilised a specific coding procedure covering methodology, review topics and context. The study shows that several research traditions have contributed to advances in the research on teaching over time. Reviews have become more formalised, but the distribution of different types of review formats and research traditions is relatively constant. The single most established review format is meta-analysis, but it is less dominant than might be expected in an era of evidence-based education. The reviewers mainly belong to educational psychology, applied linguistics/research on language teaching, or research on science teaching. Whereas most reviews of research on science teaching are qualitative, reviews performed by psychologists and language-education researchers are mainly quantitative or based on mixed methods as a way to rationally and cumulatively summarise and downsize unmanageable amounts of research..

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## Introduction: The production of reviews of research on teaching

Educational research has a long history, and the production of studies on educational matters, like research in general, has increased heavily since the 1980s, especially during the past two decades. New studies are published continuously—studies comprising research about teaching, learning, school leadership, evaluation, and so forth. This expansion has increased the production of second-order reviews of primary

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studies in order to establish what is known and how to develop further knowledge. A second-order field in educational research has emerged, with its own theoretical and methodological challenges. This overview article covers such meta-level research. More precisely, it explores the most-cited reviews of research on K-12 teaching in Web of Science (WoS) from 1980 and onwards. Most cited in this case refers to the reviews of research on teaching with the highest citation records per decade in WoS. The overview is not restricted to reviews of research on a specific teaching aspect and thus comprises a variety of second-order research on teaching.

We map this body of most-cited reviews of research on teaching found in WoS and published between 1980 and 2018 in order to describe and analyse the production of reviews, forming a second-order research topography and discussing its implications for research on teaching. Topography refers to: (a) the methodologies used in the reviews; (b) what content they cover; and (c) contextual factors concerning the authors and journals producing the reviews. The combination of these topographical components is the basis for further analyses of second-order reviewing as a major trend within research on teaching, a trend that arguably both directly and indirectly affects future research as well as education policy and school practice.

#### *Overview as a third-level analysis of research*

Polanin *et al.* (2017) have addressed the need to develop a third-level overview analysis and/or synthesis of findings from second-level reviews of primary research in order to handle the increasing numbers of educational research reviews. Polanin *et al.* (2017) mainly, although not exclusively, refer to overviews as syntheses of meta-analyses that cover original studies providing effect-sizes, a research design that excludes a body of potentially relevant reviews and research. Effect analyses generally target meticulously detailed topics, which means that meta-analyses as well as overviews in the Polanin sense cover a limited amount of research, matching strict method criteria. Polanin *et al.* argue for the term ‘overview’ as part of a well-established terminology (cf. Pieper *et al.*, 2014), though there are many alternative terms in use, such as meta-meta-analysis (Kazrin *et al.*, 1979; Hattie, 2009), meta-synthesis (Cobb *et al.*, 2009), overview of reviews (Cooper & Koenka, 2012), review of reviews (Maag, 2006), second-order meta-analysis (Tamim *et al.*, 2011), tertiary review (Torgerson, 2007), mega-analysis (Terhart, 2011) and umbrella review (Thomson *et al.*, 2010). Hattie’s book *Visible Learning* (2009) is probably the most prominent example of a third-order synthesis in education research. Polanin *et al.* (2017) refer to it as the most ambitious meta-meta-study in education so far. *Visible Learning* builds on numerous meta-analyses in order to provide informed and compelling prescriptions of what makes the optimal teaching and learning.

We choose to borrow the term ‘overview’ from Polanin *et al.* (2017), but we conceptualise it in a quite different way. Our type of overview is inclusive with regard to different kinds of second-level review research methodologies and first-level research of different orientations. The aim is not to summarise refined knowledge about teaching nor to offer any teaching prescriptions. Our overview encompasses a wide but systematically defined second-order field of research on teaching, including reviews that meet a few basic requirements. They: (a) address a topic that qualifies as a teaching

method or an approach to teaching; (b) are published in a peer-reviewed journal covered in WoS; and (c) are relatively highly cited (i.e. are the most-cited relevant reviews per decade). The main interest in this particular study is to analyse research with high impact, not in order to measure and assess different teaching methods or review standards but to explore influential trends in reviews of research on teaching (using WoS as the influence indicator). Whether this second-order research is open to different theoretical orientations we consider an empirical matter. Compared to the more strict approach in the style of Polanin *et al.*, our mission is to explore, summarise and reflect on findings from different research areas. By mapping methodology, topics and context in the most-cited reviews of research on teaching in WoS, we aim to introduce a new and productive way of analysing and discussing the significance of academic knowledge about education.

### *Purpose and research questions*

The purpose of this study, as part of a major research project, is to describe and analyse the increased production of reviews of research on teaching, revealing a second-order research topography in order to discuss this phenomenon, including its consequences for research on teaching. We do this by mapping a body of most-cited reviews of research on teaching found in WoS and published between 1980 and 2018. By exposing trends in the characteristics of high-impact reviews during three periods (1980–1999, 2000–2009 and 2010–2018), the study aims to identify patterns of change and stability in the research topography: in review methodologies (research traditions and review formats), review topics (covered teaching methods or approaches) and review contexts (author and journal characteristics). The following research questions have guided the overview:

1. (RQ1) What characterises the topography of the research reviews with regard to: (a) methodologies, or the types of research traditions and formats employed in the reviews; (b) topics, or the types of teaching topics and research on teaching that are explored; and (c) contexts, in terms of both the review producers—that is, the authors' research backgrounds, areas of expertise, affiliations and nationalities—and the review arenas, or the types of research journals that are represented?
2. (RQ2) What are the main patterns, in terms of stability and change, concerning review methodologies, topics and contexts?

In our concluding section, we address the implications of the identified review patterns (the second-order topography) for primary and secondary research on teaching, and we discuss the benefits of performing this kind of overview.

*Distinctions between methodologies, topics and contexts used in the analysis.* Methodology, topics and context in reviews of research on teaching are the three key themes in this overview. Accordingly, the overview design reflects the trinity of methodology, topics and context. In the forthcoming sections, we introduce some basic distinctions for our analyses and conclusions regarding methodology, review topics and review context, followed by a description of our search strategy and selection processes. In the Results section, we present our findings in accordance with the three discerned

themes and the distinctions made. First we present the methodologies used in the reviews of research on teaching; then we move on to investigate which topics (teaching methods and approaches) the body of most-cited reviews is concerned with; and third, we examine the production contexts of the reviews. Arguably, the last aspect—who the producers of the reviews are and in what arenas they communicate—is a crucial topography component. In the concluding section, we present our main conclusions regarding RQ1 and RQ2 and discuss the implications of these findings for research on teaching, especially with regard to review making. Finally, we argue for the use of third-order overviews in the manner introduced through this study.

The mapping of the reviews revealing a second-order topography of research on teaching constitutes the main part of this overview. We see the identification, depiction and analysis of such a topography as an important contribution to educational research in general. The topography mapping here is exploratory, given that we introduce a new type of third-order overview. In addition, the final discussion on implications of our findings for educational research and for research on teaching is rather brief, but our ambition is that it will encourage further investigation and debate.

### *Methodological distinctions*

Methodology, in this study, refers to the research tradition(s) behind the overall design of a review, including the review's implicit or explicit theoretical foundation and the reviewer's choice of method(s) and format(s) for data collection, data analysis and review presentation. Due to the necessity to somewhat limit the range of empirical analyses, our methodology analysis is restricted to research traditions and review formats. In this section, we first introduce three main theoretical strands utilised in the review mapping and analysis process. We then present distinctions regarding different formats used in reviews of research on teaching.

*Three research traditions.* As part of our coding procedure, we have distinguished three types of research traditions, labelled the functionalist, the hermeneutical (meaning making) and the critical-emancipative research traditions (Habermas, 1972; Kemmis, 2001). They cut across the different disciplines potentially engaged in knowledge production in research on teaching, such as psychology, education research (including both general and subject-specific research), sociology, philosophy, economics, history of education, computer science, and so on. Sociology of science and science and technology studies recognise these three tradition categories, after the work of Thomas Kuhn (Kuhn, 1977; see also Burrell & Morgan, 1979; Delanty, 2001), but the categories are neither clear-cut nor uncontroversial, and there are many alternative ways to categorise types of research traditions. Outhwaite (1987), for instance, distinguishes realism, hermeneutics and critical theory as the three main traditions within social sciences, while Suri and Clarke (2009) talk about positivist and neo-positivist traditions, as opposed to interpretative, critical and participatory traditions.

We use the three traditions (functionalistic/instrumental, hermeneutical/meaning-making, critical and emancipatory) empirically and analytically to distinguish different review designs as a means to examine the different knowledge interests at play in

the production of reviews of research on teaching. The main reason for choosing these rather broad theoretical categories is that a third-order overview of our kind—open for reviews in different formats of research on many different kinds of teaching—potentially covers a body of research containing quite varying theoretical points of departure. We apply the following crude definitions of the three different traditions:

- The functionalistic/instrumental tradition
  - Cumulative and partly characterised by the idea of producing evidence and knowledge for effective intervention.
  - Research aims at developing theories and then testing them, often through experimental research, most notably in the form of randomised controlled trials.
  - A common output measure at the review level is effect size, aggregating results from different studies in order to generalise findings (Gough *et al.*, 2012).
- The hermeneutical, meaning-making tradition
  - Based on the idea of a practical epistemology, opposing the dualism between immaterial mind and material world.
  - Knowledge is not fixed, but a way of doing and acting in the world. Knowing is not about a world out there but about making meaning of experiences, in the widest sense of the word *experience*.
  - Knowledge growth means expanding our conceptual schemes and horizons of interpretations (by configurative knowledge syntheses, for example).
- The critical and emancipatory tradition
  - There is a normative dimension in all knowledge production, including research reviews. Therefore, the emancipative moment of the interpretation process is essential.
  - The growth of knowledge is always biased and must be judged against value criteria concerning what ideological interest it may contribute to and who the knowledge producers are.
  - The reasonable output of research is to work out arguments that different knowledge users can critically appropriate in just and fair ways.

*Ad-hoc versus systematic reviews—a continuum.* The main distinction we make concerning review formats is unsystematic ad-hoc reviews versus systematic reviews, with meta-analysis as the review format with the strictest formal requirements. (For a more elaborated set of distinctions, see Wolgemuth *et al.*, 2017.) To be fair, these two format types represent ends of a continuum. The emergence of systematic reviews in general, and meta-analyses in particular, during the last 30 years has affected what researchers count as an adequate review, but before the 1990s there were no clearly pronounced standards regarding how to perform a review of research on teaching. Consequently, a multitude of review formats has evolved over time, in part reflecting different research traditions and different arenas for review production. Reviews of research on teaching have been published in academic journals and as parts of

anthologies, or as whole books in themselves. Simply put, review formats correspond to various review expertise ideals.

*Ad-hoc reviews*—The unsystematic ad-hoc reviews with no explicit methodology requirements mainly or solely rely on the topical expertise of the author, that is, the author's authority in the field (Gough, 2007) as a connoisseur of a particular topic. The topical expert designs the review more or less freely, usually by employing an implicit methodology procedure and sometimes with an outspoken critical mission. In ad hoc reviews, method descriptions are absent or more or less unsystematic (Gough, 2007). An ad hoc review's legitimacy rests on the author's authority derived from their expert knowledge in a particular area of interest. The ad hoc review has long been a common review format in many different publications (such as journal articles, chapters in research handbooks or surveys of the field in research monographies).

The *Handbook of Research on Teaching* serves as an example of the ad-hoc format. It includes a collection of reviews that mainly earn their legitimacy from the authors' topical expertise. The *Handbook of Research on Teaching* (published in five editions since 1963 by AERA, the American Education Research Association) is one of the first published and one of many renowned handbooks on educational research. A handbook in this style presents the current state of research in a particular academic field or area of interest, striving to be comprehensible to academic professionals but in many cases to university students, policy-makers and practitioners as well. Over the years, different academic organisations and publishing companies have produced a great variety of handbooks, including a number of subject-specific ones, summarising and critically examining research on different aspects of schooling, teaching and learning. The handbook experts have various disciplinary backgrounds and thus use different review methodologies (cf. Floden, 2011). The increased supply of moderately standardised handbooks indicates, in a way, that a multitude of review formats persist and is even more prevalent today than before.

However, the handbook review format has been called into question. As Floden (2011) has remarked, handbook reviews of research on teaching and learning 'are often narrative summaries, using a variety of formal and informal methods to condense results of many studies into short accounts' (p. 29). In sum, ad hoc reviews, like the ones found in handbooks, are reproachable for being ambiguous and unsystematic, earning legitimacy due to the authority of individual experts in the field rather than to thorough scrutinising of collective research efforts. Accordingly, the ad hoc review has been profoundly challenged by the systematic review as the preferred review ideal, although the popularity of ad hoc reviews is persistent and legitimate.

*Systematic reviews*—The systematic review has a strict and explicitly formalised review methodology. Systematic reviews, too, are often produced by topical experts, but they frequently also require specific review-method expertise. Such expertise knowledge is required for systematic reviews of quantitative research but is probably less crucial in systematic reviews of qualitative research. (For a more elaborated categorisation of systematic reviews, see Wolgemuth *et al.*, 2017.) Systematic reviewers meticulously outline and justify the analytic processes applied to the information

obtained from or about the constituent studies, and the methodological development concerning systematic reviews has been intense. The procedures used to synthesise findings from both qualitative (Dixon-Woods *et al.*, 2006; Sandelowski & Barroso, 2007; Thomas & Harden, 2008; Barnett-Page & Thomas, 2009) and quantitative studies (Gough, 2007) have undergone increased scrutiny and development by an increasing number of scholars.

The call, from the 1980s and onwards, for increased systematicness in reviews is partly a consequence of the plethora of review formats in educational research, including research on teaching. This diversity met with the criticism that it reproduces and contributes to the perpetuation of a weak research field in which expert opinion weighs more than empirical proof. Many educational researchers have stressed the importance of establishing standards and rigour as means of securing scientific quality and transparency in the production of research reviews. Meta-analysis, a concept introduced in 1976 by Gene V. Glass in a presentation for AERA (see Glass, 1976), became a rapidly growing format in the social sciences, medicine, and education from the 1980s onwards (Glass, 2006; Shadish & Lecy, 2015). The introduction of meta-analyses and the emerging evidence movement have led to a major push for the explicit use of a rigorous methodology that applies formal procedures for systematic reviews in education as well as in many other disciplines. A Google search of 'meta-analysis\*' and 'education' yields about 309 million hits (in a Google search performed 15 May 2019), which indicates that the evidence movement exists on a major scale worldwide. This is clearly the case in the popular press and in political debates, where *meta-analysis* and *evidence-based* have become key terms addressing not only medicine and health but also education, not least teaching. In our analysis, we will address to what extent the requirements and expectations associated with systematic reviews is present in the body of most-cited reviews of research on teaching found in WoS, and whether this has changed over time.

### *Topical distinctions*

The different review ideals described above correspond to trends and traditions in primary research. Educational research in general, and not least research on teaching, has always been a cause for debate. Different research trends at both the primary and secondary levels have affected the research field, just as trends in teaching as a practice have had a research impact. Primary and secondary research on teaching quite naturally connect to teaching practice, though similar trends are hardly ever simultaneous or identical at the different levels, since research communities and schools act under very different conditions.

In our analysis, we distinguish two topical dimensions that reveal tensions between generalisation and specialisation when it comes to teaching; that is, they help pinpoint the efforts and limitations of standard models for teaching. Thus, we take an interest in the aspirations of the reviewed teaching method or approach, according to the reviewers and/or the reviewed primary research. The tensions between generalisation and specialisation regarding teaching resemble and partly reproduce similar tensions in primary and secondary research on teaching, where, not least, systematic reviewing is motivated as a means to provide solid, generic knowledge.

The two topical dimensions we distinguish are: (a) teaching as a generic or a context-/content-dependent phenomenon (the degree of generalisation claims) and (b) the aspect scope of the teaching methods/approaches. The first dimension concerns whether a review regards the teaching method or approach under scrutiny as applying to all or as restricted to specific student groups (according to age or school form) and/or subject content. The line between method and approach is not clear-cut, but method in this sense refers to an explicitly defined and recognised way to perform teaching, as opposed to an approach. Problem-Based Learning (PBL), for instance, is an established teaching method, whereas the use of virtual-reality resources in teaching rather represents a teaching approach. The second dimension concerns whether a review regards a more restricted aspect of teaching, such as teaching and learning grammar, or a more general aspect, such as teachers' questioning behaviour.

In all, our distinctions serve to underpin an analysis that takes into account the interplay between primary and secondary research on teaching in relation to underlying research traditions (see previous sections). In a historical perspective (further summarised in the following subsection), those two levels of research are closely intertwined and at the same time divergent:

- Research on teaching is rooted in school practice. It may build on theories in any of the three theoretical traditions described above and may be performed through classroom observations, experiments on how humans learn things, and/or analyses of sociocultural or historical conditions of schooling, but its major point of legitimacy is arguably its educational relevance. Research on teaching is a heterogeneous field, employing a multitude of methodologies and theories. This research pluralism has increased over time.
- Reviews aim at summarising and evaluating research on teaching and thus link to school practice, too. Indeed, that is a common argument for the production of systematic reviews of different sorts. Still, as second-order research, reviews might also add to the research–practice gap, which original educational research has often been criticised for (Hirsh *et al.*, 2020). Specific review methodology requirements risk making the review a matter of technicality or academic introversion. Reviews and review formats for secondary research on teaching partly reflect the primary research pluralism, though the increase in systematic reviews works as a means to counteract such pluralism.

*Trends in research on teaching—some historical remarks.* Educational psychology, which is mainly oriented towards teaching and learning as a matter of method, has largely dominated the research field during the last 100 years. This is especially the case in the USA, where educational psychology scholars tied to teacher education institutions have performed research on teaching since the 1920s. AERA played a major role as a gatekeeper in upholding a strong experimental psychology research tradition of 'logico-deductive studies and experimentation' (LeCompte, 2009, p. 26).

Research rooted in experimental psychology was eventually criticised for treating teaching and learning as matters of behaviour and functionality, for extracting techniques for knowledge transmission and acquisition while disregarding contextual factors and individual dispositions. The critics argued that such research preserves a

traditional teacher–student relationship and overemphasises teaching at the cost of students’ learning and/or reduces the teacher to an instrument for knowledge transmission (cf. Magoon, 1977). Some critics, such as Shulman (1986), claimed that an obsession with teaching methods had led to a content blindness, disregarding subject-specific differences.

Alternative research traditions in psychology and in other disciplines introduced new (and renewed) ways to improve teaching and learning in general and/or to understand schooling and teaching as social and cultural phenomena. Student-centred approaches to teaching, often building on constructivism, became common from the 1960s and onwards, promoting classroom activities wherein the students ‘arrive at meaning by actively selecting, and cumulatively constructing, their own knowledge, through both individual and social activity’ (Biggs, 1996, p. 345). Constructivists have generally emphasised that student-centred methods have both cognitive and social merits, thus recognising the social and democratic aspects of schooling and of research in new ways. In this, constructivism marked a notable shift in the modern history of teaching and research on teaching. However, since constructivist-based teaching and learning had its roots in developmental psychology, it is compatible with the instrumental tradition of experimental research on teaching, sharing a belief in systematic evaluation as a means to improve teaching. (See Magoon, 1977, for an early initiated summary of constructivist theories in education.)

The post-structuralist and critical theories on education and teaching that gained popularity in the late twentieth century mark a sharper paradigmatic shift, in the Kuhnian (Kuhn, 1977) sense, compared to constructivism, not least when it comes to the purpose(s) of education. This group of theories emphasises the social dimension of knowledge as a crucial aspect of all teaching, learning and education. Post-structural theorists argue that any cumulative research efforts to decide on best practices in education and teaching are vain and socially biased.

The AERA handbook on teaching illustrates the trend shifts over time, from an American perspective, as LeCompte (2009) has shown. Whereas the first two editions (1963, 1973) were completely restricted to methodologies within a logico-deductive, positivist and quantitative tradition, emphasising empirical testing of outcomes and effects of different teaching methods in order to develop theories on human learning, the third, 1986 edition reflects an increased constructivist impact. In addition to the previously established methodologies, it introduces philosophy of research on teaching, qualitative studies, ethnographic observation and syntheses of research on teaching (LeCompte, 2009). In contrast, the two latest editions, of 2001 and 2016, reflect the impact of post-structural and critical theories such as mixed methodologies, narratives and discourse analysis and affirm research pluralism, while clearly dethroning the research perspectives of educational psychology (LeCompte, 2009; Gitomer & Bell, 2016). The fifth edition (Gitomer & Bell, 2016) seems to embrace research pluralism even more, with regard to both topics and methods, addressing a broad range of teaching methods and approaches, including subject-specific teaching, teaching diverse student groups and students with special needs, and different social and political aspects of teaching.

In summary, the topical trends in research on teaching, as part of educational research in general, are contradictory. On the one hand, educational research—like

many other research fields—has become increasingly multifaceted and heterogeneous. Its different branches have become more specialised and divergent in terms of topics, methods and theoretical standpoints. On the other hand, experimental research on teaching and education, mirroring research in the natural sciences, has regained its position (if it was ever really dethroned), which the strong call for systematic reviews indicates. The compelling endeavour to utilise research has led to an increased demand for research summaries and syntheses that either aim to provide a bridge between different types of research or formulate strict criteria for valid research, thereby ruling out other research as invalid.

*Review producers and arenas in research on teaching through the lens of WoS.* Who are the researchers producing reviews of research on teaching found in WoS? Well, since research reviewers produce knowledge at a secondary level, they actually summarise knowledge on teaching. As mentioned above, this determines the kind of researchers involved. Both primary studies and research reviews in the field of teaching primarily involve one of two kinds of experts: researchers with knowledge in the field (topical expertise) and methodological specialists (those with research-method expertise). In the case of reviews, however, the emphasis on specific method requirements is arguably stronger, particularly in meta-analyses. The increased demand for systematic reviews is a trend that primarily influences second-order research, though it may also set new standards for primary research on teaching. The mapping of review methodologies and topics, completed with fundamental background data on the review producers and the arenas (i.e. the authors behind the most-cited reviews and the journals publishing those reviews, respectively) provides a relatively solid ground for exploring change and stability in the topography of research on teaching, as it emerges through the lens of WoS.

The journals publishing the reviews clearly constitute an especially important contextual factor, as they are very significant gatekeepers for establishing and upholding specific research virtues, with varying degrees of formal requirements. The degree of formalisation regarding legitimate review formats and other journal standards reflects the extent to which a review (a) produces knowledge based on a distinct set of ideas and (b) is recognised by the research community to which the review/reviewer(s) belong (Maton, 2000). In a highly formalised research field, established insiders produce reviews; consequently, the arenas for communication and development clearly define the boundaries for what will be published. At the same time, this means that any novice can learn the methods and rules for arguments and inferences to participate successfully in the field.

*Web of Science as a meta-arena for review production.* Our ambition has been to track down influential reviews of research on teaching published during the last 40 years, with an openness to different kinds of research and teaching (including general/generic as well as subject-specific methods and approaches). To accomplish that, we have utilised Web of Science (WoS), a multidisciplinary research database that earns a reputation for being, on the one hand, prestigious and extensive (Li *et al.*, 2018) but, on the other hand, restricted and biased in a number of ways (in terms of publication formats as well as language and discipline coverage). Google Scholar

(GS), for instance, covers far more research, especially within the social sciences and humanities, but it still has some bibliometric flaws concerning metadata and making distinctions between peer-reviewed and unauthorised publications (Martín-Martín *et al.*, 2018). Ranking the most-cited publications within a specific area is not yet possible in GS. Like Martín-Martín *et al.* (2018), we argue that high citation rates in GS might reflect the impact on higher education and teaching practice, while high citation rates in WoS (or Scopus) to a larger degree reflect scientific impact. This is not a normative stance but a fruitful point of departure for a third-order mapping of a second-order research topography.

At the meta-level, so to speak, WoS functions as an important gatekeeper. WoS is owned by Clarivate, a company providing data analysis services tied to research, patents, pharmaceuticals, biotech and trademark protection (Clarivate, 2020). WoS indexes a massive amount of research but covers far from all studies. According to Clarivate (2020), the selection process builds on three principles: ‘objectivity, selectivity and collection dynamics’. Its numerous inclusion criteria (28 altogether) purport to ensure a massive but selective collection of research, restricted to studies of high quality and impact (*ibid.*). In this sense, WoS sets clear standards for what counts as high quality, influential research. These standards directly affect journals and researchers striving to be represented in WoS (as a token of scientific acknowledgement) but also indirectly affect journals and researchers who ignore the WoS requirements or explicitly object to them.

In spite of its stated ambition to be impartial, WoS has met with criticism for being biased towards research in English, especially Anglo-American research, and towards research in the fields of science and engineering (Mongeon & Paul-Hus, 2016). Another issue concerning WoS is what ‘most-cited’ in that collection of databases really indicates. Whether the most-cited reviews in WoS really are the most influential is contestable. Influential and high impact are vague terms (influential where, and to whom, and over what period of time?), and there are arguably a number of well-cited journal publications that qualify as reviews of research on teaching but are omitted by WoS because its criteria apply only to journals, not to individual articles. In addition, many relevant reviews are published in books and anthologies (including handbooks) and are therefore excluded from WoS. The WoS platform is, in other words, a prominent though challenged gatekeeping meta-arena.

### *Search, selection and coding process*

The project takes a methodological approach based on the X format (X, 2017), which stresses the importance of analysing different kinds of recognised high-impact research on a specific matter, taking into account the studies’ different theoretical and epistemological standpoints, methodologies, and so on. Our analysis includes a five-step procedure:

1. Discerning relevant research arenas in which researchers interact, or cite each other.
2. Identifying research with a high impact in each arena, i.e. numbers of citations.

3. Assembling background data about the material, e.g. authors and their genders, disciplines and institutional affiliations.
4. Categorising the material by genre and formats, i.e. meta-analyses of efficacy and effectiveness studies, empirical research reports, concept reviews, and so on.
5. Mapping and analysing central aspects of publications regarding (a) topics, (b) theoretical traditions, (c) theories, (d) methods, and (e) outcomes.

The choice of Web of Science (WoS) is motivated by its status as an authoritative research platform that is well suited to mapping prominent research concerning education and teaching, even though it includes far from all reviews of research on teaching published in the world. WoS has been criticised for favouring (a) research in English; (b) Anglo-American research; and (c) science research, that is, the natural sciences, engineering, and biomedical research (Mongeon & Paul-Hus, 2016).

*Reviews of research on teaching as an object of research.* The searches were restricted to WoS, so we used the WoS citation index. By using a specific search string matched towards titles, abstracts and keywords, we singled out the most-cited research reviews on teaching methods and approaches in K-12 schools from each decade. We performed two types of searches, combining a single and a double search-string procedure. The reason for performing two different searches was that we initially relied on the WoS labelling of research, but we had to do a complementary search in a second step because the tagging of research reviews in WoS proved insufficient. Our definition of reviews of research on teaching includes various kinds of research-review formats and traditions within the research field. We used the following search strategy:

1. A search in WoS Core Collection using the simple search string “teach\* OR instr\* OR curric\* OR did\* OR coach\* OR guid\* OR tut\*”, restricted to topics within reviews in the four pre-defined areas for research related to education (*Education Educational Research, Psychology Education, Education Scientific Disciplines* and *Education Special*) for the time spans 1980–1989, 1990–1999, 2000–2009 and 2010–2018. This search yielded, respectively, the following number of hits: 192, 446, 1241, and 2439.
2. A search in WoS Core Collection using the combined search string “teach\* OR instr\* OR curric\* OR did\* OR coach\* OR guid\* OR tut\*” AND “review\* OR meta-analys\* OR meta-narrative\* OR meta-synthes\* OR overview\*”, restricted to topics within articles and reviews in the four areas *Education Educational Research, Psychology Education, Education Scientific Disciplines* and *Education Special* for the time spans 1980–1989, 1990–1999, 2000–2009 and 2010–2018. This search yielded, respectively, the following number of hits: 166, 1915, 3788 and 13,795.

After duplication and relevance screening, a number of publications met the eligibility criteria based on title and abstract, and the corresponding full-text articles were procured for review. After data characterisation of the full-text articles, 75 reviews remained and were included in the analysis. In this study *most-cited* refers to relevant reviews with the largest total number of citations. We could have chosen reviews with the highest average citation rate per year instead, but that would have been too time consuming.

*Eligibility criteria.* The reviews in the corpus met the following inclusion/eligibility criteria:

1. The article was explicitly defined as a review (or any of the alternative denotations *meta-analysis*, *meta-narrative*, *meta-synthesis* or *overview*).
2. The review article primarily, and not as a part of an original study, reviewed previous research on a particular teaching method or approach. Some reviews were excluded because the reviewed research was mainly or wholly restricted to research performed by the reviewer. Others were excluded because the research review was only a minor part of the article.
3. The review incorporated the aspect of teaching students in child and youth schools. We excluded reviews restricted to teaching in pre-school or higher education. Reviews with general claims about teaching (regardless of type of school or age) were included, provided they covered K-12 schooling.
4. The review addressed the reviewed research topic as a matter of teaching (including teaching methods and approaches, settings, and devices). We included reviews on teaching forms and methods that mainly focus on the ways teaching is framed and performed, though they could also address teachers' thinking and actions, student characteristics, or restricted aspects of teaching subject-specific content. This criterion led to the exclusion of reviews that address only learning (with no reference to school or instruction) and reviews on personal or psychological aspects of the teacher, as well as reviews on the ways teacher/student attitudes affect student achievement—unless the reviews concerned, in addition, a specific teacher strategy or intervention, in which case they were included.

*Selection of periods and reviews.* The review field including meta-analyses and other kinds of systematic overviews has exploded over the last 20 years, in education as in many other scientific areas. For example, the number of reviews increased from  $n = 1910$  in the 1990s to  $n = 3779$  during the years 2000–2010, that is, by nearly 100%. Our analysis includes the 10 most-cited reviews from the 1980s that met our criteria and the 15 most-cited reviews from the 1990s, followed by the 25 most-cited reviews from the 2000s and the 2010s. We regard 1980–1999 as a formative era for research syntheses, with a low but slowly increasing number of reviews and a similar citation development. Our fixed number of reviews per period is mainly practical and not in proportion to the almost exponential increase in the number of reviews. The corpus of 75 most-cited reviews (see Appendix 1) includes reviews of research on school teaching that vary in many aspects, including their citation rates (see Table 1 below). Three reviews had more than 1000 citations each as of August 2018, but two-thirds of the sample (50 of 75) were cited less than 300 times.

Reviews from the 1990s (as a subdivision of the 1980–1990 period) and the 2000s had a much higher average citation rate than reviews from the sub-period of the 1980s and reviews from the 2010s (see Table 2 below).

In the case of the 1980s, the fact that research reviews were still rare partly explains the relatively low average citation rate. In addition, access to reviews of the pre-internet era of the 1980s was more restricted. In all, it is not surprising that older reviews

have lower annual citation rates (see Table 3), since there is a trend factor involved in citation persistency.

In the case of the 2010s, the relatively low citation rates are clearly due to the novelty of the reviews, that is, their short time of exposure. In addition, the extremely strong expansion of reviews in the 2010s—including increases in every different domain of research on teaching—arguably makes it harder to reach a high citation rate. Table 3 shows that, apart from a few blockbusters (2 reviews with more than 100 annual citations on average), the main part of the corpus consists of reviews with moderate or low annual citation rates. During our mapping process, we noted that there were a large number of low or uncited reviews of research on teaching produced in the 2010s.

*Review coding and background mapping.* Two researchers in our project group coded the reviews according to a formalised coding protocol. The protocol consisted of 27 categories covering basic background data (e.g. affiliations and disciplinary background), methodological characteristics, review data, theoretical foundations, knowledge interests, and so on. Two members of the research group were in charge of the fundamental coding, balanced by continuous inter-rater reliability tests performed by

Table 1. Citation rate distribution

Citation rate	Total number of reviews	1980s and 1990s	2000s	2010s
1000+	3	-	2	1
500–999	11	4	7	-
300–499	11	6	4	1
200–299	19	6	10	3
100–199	23	8	2	14
80–99	8	1	-	6

Table 2. Average citation rate per decade (total number of citations divided by the number of reviews)

	1980s (10 reviews)	1990s (15 reviews)	2000s (25 reviews)	2010s (25 reviews)
Average citation rate	179.4	390.7	442.5	190

Table 3. Distribution of reviews according to annual citation rate (total number of citations per review divided by the number of years since publication)

Annual citation rate	>100	50–99	30–49	20–29	10–19	<10
Total number of reviews	2	2	12	18	30	11
1980s and 1990s	0	0	2	2	10	11
2000s	1	2	5	8	9	0
2010s	1	0	5	8	11	0

the whole research group. In a second step, this coding was refined (going into further detail) as part of preparing this article. This step included a thorough mapping of review topics (covered topics on teaching) and review context (author and journal background information) by using different web resources, such as ProQuest and institutional webpages.

## Results

In the results section, we present our main findings in the mapping of three review aspects—methodology, topics and context (RQ1). Together, these form an intriguing research topography, with some rather distinct patterns concerning stability and change in the interplay between primary and secondary research on teaching (RQ2). Figure 1 illustrates what components make up the topography in this overview. The model captures at least some of the complexity in the relationship between second order reviews and primary research on teaching, where reviewers and journals work as the mediators.

The model aims to guide the reader through this rather straightforward and slightly prosaic section. We have found such an approach to presenting our findings useful in order to provide a clear outline of the topography revealed and to separate the different levels of research involved.

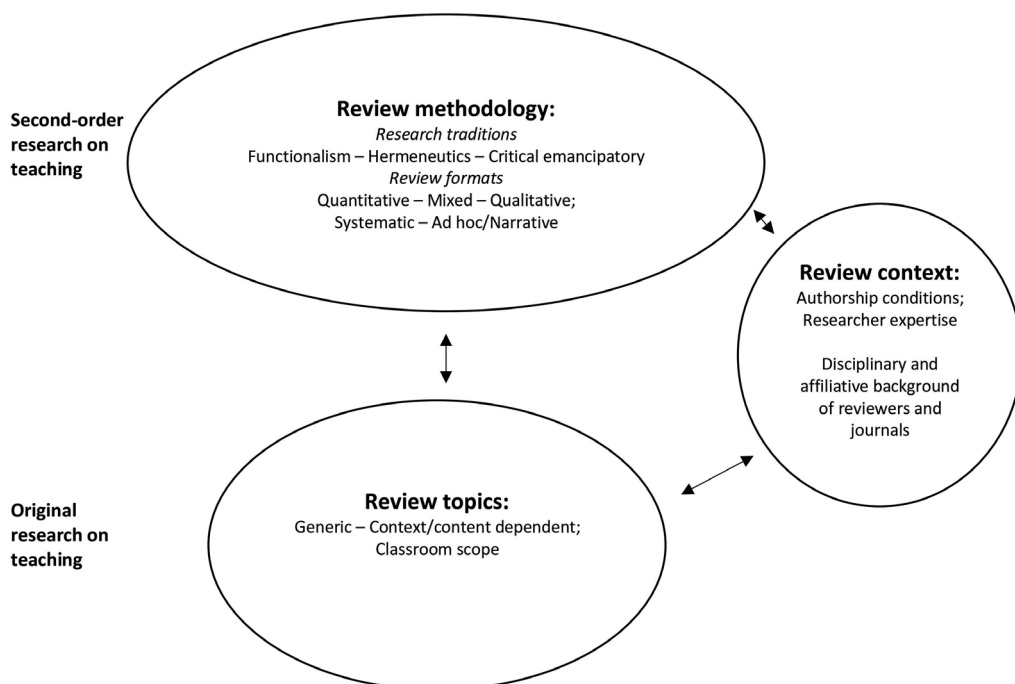


Figure 1. Review methodology, topics and context components

*Review methodology: Formats and research traditions in the reviews*

In this section, we present our findings concerning methodology, starting with the different formats used in the reviews, which in turn tie to differences in research traditions and knowledge interests.

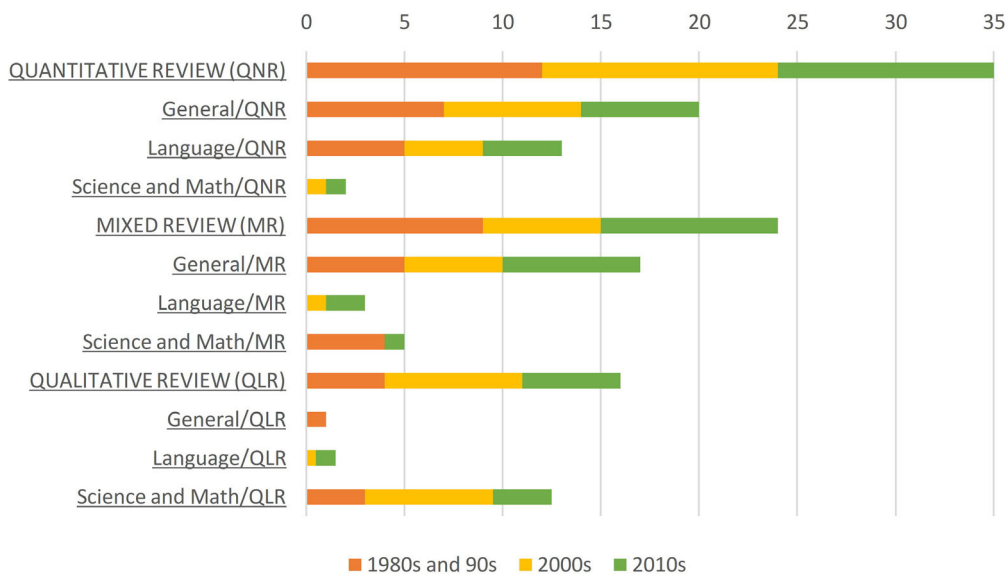
*Review formats: A consistent and substantial share of meta-analyses.* Figure 2 summarises the distribution of reviews per period concerning review format and type of research on teaching:

In general, the format of a review is largely determined by the type(s) of data used in the primary studies it covers. For example, quantitative reviews build on quantitative primary studies, and they mainly review them with quantitative means. Nearly half of the reviews we examined (35/75) are quantitative in that sense, and the majority (61/75) of the reviews are coded as either quantitative or mixed. The quantitative reviews are evenly distributed over the three periods, and of those 35 reviews, 28 are meta-analyses. The periodical distribution of meta-analyses is slightly but not significantly uneven (8, 11 and 9).

Nearly a third (24/75) of the reviews are mixed, that is, they report both quantitative and qualitative data. The latter—qualitative data in mixed reviews—refers in some cases to reviewing theoretical reasoning in original studies, as the reviews in this category are, to varying degrees, concerned with both exploring the conceptual and theoretical foundations for a certain approach and examining its empirical support. Many mixed reviews and almost all quantitative reviews are methodologically formal in a way similar to the proclaimed meta-analyses, and they generally emphasise the need for evidence support.

A third type of meta-research is explicitly qualitative (16/75). As shown in Figure 2, almost all qualitative reviews concern research on science teaching, and they are particularly prominent during the 2000s. Quantitative reviews mainly address either general teaching approaches (20/35) or language teaching (13/35), whereas only two such reviews relate to science teaching. The group of mixed reviews reporting both qualitative and quantitative data findings vary greatly in terms of theoretical foundation, methodological rigour and use of different types of data. Mixed reviews mainly concern general aspects of teaching (17/24). We will come back to why the general reviews largely build on quantitative data, which in short has to do with the reviewers' academic backgrounds, mainly in educational psychology, and the persistent drive in educational research to produce and authorise generic formulas for schooling.

Reviews of research on subject teaching are obviously not uniform; they seem to follow two very divergent tracks. Reviewed research on language teaching seems mainly to have been addressed quantitatively, assessing the efficiency of language acquisition through different types of instruction styles and/or within different specific aspects of the subject. Research on science teaching (as reflected by the reviews under scrutiny) seems to have been more concerned with exploring and contesting the boundaries of science as a subject, including the consequences for how to teach and learn it. This will be further explored in the Review Topics section.



\*QNR= quantitative review, MR=mixed review, QLR=qualitative review

Figure 2. Distribution of review formats per period and type of research on teaching

*Review formats: Methodological declarations and quality assurance.* The included reviews vary widely in terms of describing their review methodology. Besides *meta-analysis*, there is no fixed format terminology established in the corpus, though *systematic review*, *research review* and *critical review* are used in some cases. Except for meta-analyses, there are only a few examples in the corpus where reviewers explicitly apply other specific and predefined methodological procedures, though many present their considerations on the methodology used. In addition, a substantial part of the most-cited reviews could be described as ad hoc reviews that rely on the authors’ authority in the field (Gough, 2007), or their topical expertise, without explicitly reporting inclusion and exclusion criteria for choosing relevant studies. This is more common during the first period (1980s and 1990s).

Most methodological self-descriptions present reviews and syntheses as a type of literature that identifies and characterises or maps the available research on a particular topic. However, there are some divergences in how review authors characterise the rigour of the review methodology. A scarce majority of the reviews (42/75, or 56%) include an explicit and documented search strategy, and 38 (51%) include explicit selection criteria. The terms *systematic*, *rigorous*, *replicable* and *transparent* are frequently used in these reviews to describe the methodology. In contrast, some of the reviews describe their methodology as less rigorous or systematic than a systematic review. The degree of formalisation clearly increases during the 2010s. In the 2010s sample, 20 of 25 reviews include an explicit and documented search strategy, compared to 11 in each of the two preceding periods. This indicates that reviewers have generally become much more aware of using and reporting more formalised review procedures.

Details about the data characterisation (or charting) of original studies vary but are often quite sparse. Forty-five reviews (45/75) report more or less detailed information about the included studies, while only 14 reviews assess the methodological quality of the original studies reviewed. There are different factors that might explain the relatively low share of reviews assessing methodological quality of the reviewed primary research. A number of reviews explicitly report the reason quality assessment is omitted: either that it is not a review priority or that it is part of the review methodology. In the case of systematic reviews, and in meta-analyses in particular, reviewers might consider the selection process in itself sufficient to guarantee a certain level of quality, making further quality assurance unnecessary, an argument advocated by many systematic review designers. (For an evaluative insight in the rationales of meta-analysts, see Hohn *et al.*, 2019.)

*Research traditions in reviews: Domination of functionalism but with varying aims.* The varying formats presented above correspond with different meta-theoretical, theoretical and methodological approaches in the review corpus. In order to outline some of the basic features of the research traditions involved, the coding and analyses of the reviews focused on the scope and aims of the reviews and the extent to which these were explicitly stated. Four main categories were originally used: (1) field descriptive, (2) question driven, (3) argumentative, and (4) polemic. While the field-descriptive review is rather general and wide ranging in scope, the question-driven review is more specific and very empirically oriented (e.g. *Will a certain type of reading instruction improve learning outcomes?*). An argumentative review is normative and uses previous research studies, in some cases without testing their validity, to illustrate a position. Polemic refers to a type of review in which the reviewers openly position themselves by challenging and criticising another position. Partly for practical reasons, we treat polemic as a subcategory of argumentative. The distribution over time of the three types of review purposes and aims (argumentative or polemic, field descriptive, and question driven) is shown in Figure 3.

In all, there is a clear tendency towards a shift over time towards question-driven reviews, which dominate during the 2000s and 2010s at the cost of field-descriptive, argumentative and polemic reviews. This indicates that more specialised reviews based on empirical data have increasingly gained more interest among scholars in the field. The fact that two-thirds of quantitative reviews before 2000 were field-descriptive rather than question-driven also points to this trend. However, it is also worth noting that field-descriptive and argumentative or polemic reviews represent more than half of the 50 most-cited reviews in the two final periods (the 2000s and 2010s).

The issue of different purposes and aims leads to the related issue of research traditions. Figure 4 shows the research traditions the different reviewers subscribe to, according to our coding scheme.

The general characteristic of the review topography is a rather constant and strong dominance of reviews grounded in the functionalistic/instrumental research tradition, as Figure 4 shows. Such reviews represent almost two-thirds of the total corpus, evenly distributed over time. This fact can be tied to the disciplinary backgrounds of the reviewers (see the section Reviewer expertise: Educational psychologists, review makers and topical investigators) and, of course, to the prevalence of meta-analysis.

More than one third (28/75) of the reviews use the term *meta-analysis* to characterise the methodological approach and design of the review, and the shares of meta-analyses and quantitative reviews are rather constant over time. In relation to the assumption that meta-analysis is equivalent to evidence-based research, the relatively constant share of meta-analyses and quantitative reviews indicates, on the one hand, that the so-called evidence-movement has not influenced citation patterns among scholars in the field in this regard. On the other hand, we notice an increased degree of formalisation in all reviews, regardless of research tradition, and a growing number of question-driven, mixed data reviews with the stated aim of establishing evidence for ‘what works’ in the field of teaching and instruction. Those tendencies, too, indicate a stronger inclination among reviewers of teaching research to adhere to a more standardised methodological toolbox designed to ensure evident empirical support.

*Review methodology summary.* Table 4 summarises our empirical research review analyses in relation to three research traditions. These three traditions correspond to different review methodologies, including: (a) purpose and knowledge interest; (b) review format; (c) types of data presented and used in the reviewed studies; (d) degree of formalisation or systematisation; and (e) type of teaching claims. In the case of (b), there is a clear correspondence between methodology and research tradition. There is also a certain correspondence in the case of purpose and knowledge interest, but it is less distinct. However, there is no clear-cut correspondence between research

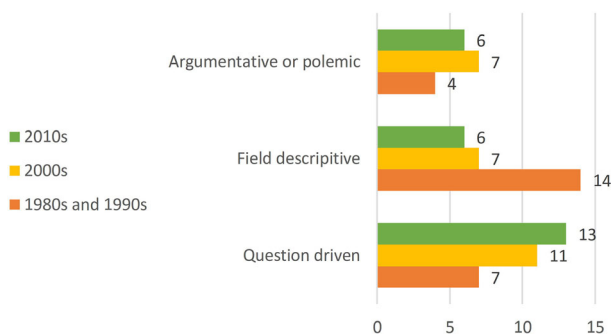


Figure 3. Purposes and aims of the reviews per period

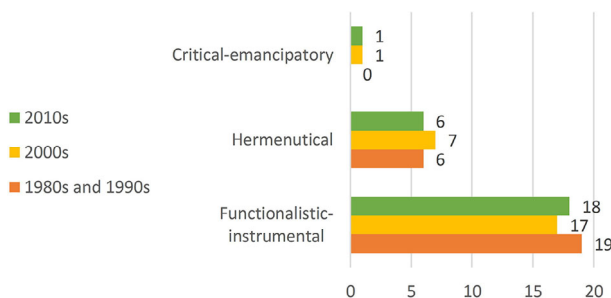


Figure 4. Research traditions of the reviews per period

tradition and type of teaching method or approach concerning subject-specific content and specific aspects of the teaching method/approach (e), and the extent to which this plays out at the review level is an open question. In all, the table indicates a certain variation in review design, not least among the reviews categorised as functionalistic/instrumental.

### *Review topics*

The 75 reviews cover a wide range of teaching methods and approaches, forming interesting patterns, where some are continuous over time and others are quickly emerging and changing. One overall pattern is a tendency to generalise teaching, and reviewers do that more than authors of the original studies, but the reviewers vary when it comes to what they generalise. This shows in at least three ways: as a matter of (a) the context of teaching; (b) subject-specific content; or (c) teaching-aspect scope.

*Teaching dimension 1: Teaching as a generic or a context-/content-dependent phenomenon.* Not very many reviewers explicitly restrict their reviews to a certain student age or school form for the teaching method/approach they review. Most reviews explicitly or implicitly cover school education in years 1–12 or higher. (For age group restrictions in the reviews, see Appendix 1.) Although many reviews report and discuss variations concerning age groups and school forms in the underlying studies, most of them downplay or even disregard the importance of these factors for the teaching method or approach involved. This may be a consequence of the review format when summarising and synthesising a number of disparate studies. Some of the reviews of research on language teaching deviate from this pattern, however, by clearly addressing aspects of language acquisition among younger children.

An adjacent type of generalisation concerns whether the method or approach is applicable to all kinds of teaching, regardless of school subject. In this case, the pattern is different from that concerning age and school forms. Subject-specific reviews make up half of the reviews in our corpus (37/75), whereas the other half (38/75) deal with teaching as a general phenomenon. The general reviews vary when it comes to recognising variations related to school subject, but, as in the case of age and school forms, the dominant endeavour is to assess the generic range of a certain teaching method or approach. The subject-specific reviews belong to two separate domains: language (including literature), and science and maths. The review corpus covers no other subject-specific areas. In our body of research, 16 reviews address science and mathematics teaching, whereof only 3 reviews concern mathematics and 20 reviews address different types of language instruction. One review compares science and language education research.

*Teaching dimension 2: Teaching-aspect scope.* The covered teaching methods or approaches also vary concerning their teaching-aspect scope. Whereas some reviews deal with narrowly defined aspects of teaching, others examine research on methods and approaches in more general terms. The following categorisation of the covered

Table 4. Research traditions and review methodology in the second-order field of research on teaching, based on 75 most-cited reviews 1980–2018

Research tradition	(a) Purpose, Knowledge Interest	(b) Format	(c) Data	(d) Degree of formalisation	(e) Generality/ Specificity
Functionalistic/ Instrumental (54/75)	<b>Question driven*</b> Field descriptive Argumentative/ Polemic	<b>Meta-analysis</b> Systematic review Research review Critical review	<b>Quantitative</b> Mixed Qualitative	<b>Explicitly high</b> High and implicit Low and implicit	General or subject specific Wide or narrow teaching-aspect scope (scope of the teaching method/ approach)
Hermeneutical/ Meaning-making (19/75)	<b>Field descriptive</b> Argumentative/ polemic	<b>Research review</b> Systematic review Critical review	<b>Qualitative</b> Mixed	<b>Low and implicit</b> Explicitly high High and implicit	General or subject-specific Wider or narrow teaching-aspect scope
Critical- emancipative (2/75)	<b>Argumentative/ Polemic</b>	<b>Critical review</b> Research review	<b>Qualitative</b>	<b>Low and implicit</b> Explicitly low	Subject-specific Wide teaching-aspect scope

\*The most common types are indicated in bold.

topics builds on the range of the covered method/approach, as that forms the basis of a review and to some extent reveals its theoretical underpinnings:

- Reviews on teaching approaches that explicitly view education from a societal or a humanistic perspective (overall/generic approaches with societal or humanistic aspirations: 6/75 reviews. This refers to the number of reviews that match the particular scope category. Some reviews match more than two categories and are thus included twice.).
- Reviews on overall teaching methods or approaches with more or less generic claims (36/75), often supported by a comprehensive theoretical framework and focusing on classroom interplay and/or individual learner outcomes. This may include more restricted teaching aspects, provided the aspect is explicitly tied to a more generic claim.
- Reviews on more specific aspects of a teaching method or a subject-specific content (specific method or content aspects: 23/75).
- Reviews on teaching in an information and communication technology (ICT) context (teaching including ICT artefacts: 15/75).

*Major topical patterns and trends.* Tables 5–7 (covering general teaching reviews, science and math teaching reviews, and language teaching reviews, respectively) summarise the different teaching methods and approaches covered by the 75 reviews, distributed according to the five categories of teaching-aspect scope presented above.

Table 5 summarises teaching methods and approaches that reviewers treat as more or less generic, that is, usable in different educational settings, regardless of content, age group, school form, and so on. Four methods or approaches are accounted for twice in the table, as they belong to two different categories. This group of reviews covers a wide range of methods and approaches, with constructivist-related generic approaches forming a prominent unit (10/37).

Table 6 summarises teaching methods and approaches that concern teaching and learning of language, either the mother tongue or a second language. One approach (L2 instruction with ICT) appears twice in the table, as it belongs to two different categories. This group of reviews is dominated by two topics: reading comprehension teaching (11/17 reviews) and second language instruction (5/17 reviews).

Table 7 summarises teaching methods and approaches that concern the teaching and learning of science and mathematics (21/75). One method/approach is accounted for more than once in the table, as it belongs to two different teaching-aspect scope categories. Most notable is the strong interest for constructivist-related approaches (10/21) and reviews concern scientific literacy (4/21), as this reflects the methodological differences in secondary (and primary) research on science teaching compared to secondary (and primary) research on general teaching or language teaching.

*A long-lasting drive to evaluate constructivist methods.* The general pattern in the corpus is that reviews in the broad category *overall/generic teaching methods or approaches* dominate. This broad category includes a variety of methods that focus on classroom interaction, which is arguably the core of teaching for enabling learning. Many of the covered topics in this category closely connect to constructivist theory. In all, 20 reviews (10 general reviews and 10 reviews on science teaching) concern teaching explicitly tied to constructivism, that is, typical progressive teaching approaches with generic aims such as cooperative learning, small group instruction, inquiry learning, problem-based learning, discovery learning and reciprocal teaching. These different kinds of methods are often contrasted with a more traditional, authoritarian teaching approach, as they stress the importance of communication and interaction between teachers and students and among students. Concerning format, these reviews are either meta-analyses or more configurative reviews, usually building on both qualitative and quantitative data from original studies.

Most of the reviewers of research on progressive, constructivist-derived teaching are topic experts in the area; consequently, many of them are more or less outspoken proponents of the reviewed teaching approach. But there are also reviewers of this type of research whom we would define as either methodological or ‘neutral’ field-descriptive experts (in both cases with no manifest theoretical interest in shaming or blaming the reviewed approach) or outspoken proponents of a different theoretical viewpoint. In the latter case, the mission is more clearly to dismiss the constructivist stance and the teaching methods derived therefrom. The most cited review in the corpus, ‘Why Minimal Guidance Does Not Work: An Analysis of the Failure of

Constructivist, Discovery, Problem-Based, Experiential, and Inquiry-Based Teaching’ (Kirschner *et al.*, 2006) exemplifies this critical standpoint, as the blunt title indicates.

The Kirschner *et al.* review builds on the educational psychology theories of cognitive load and human cognitive architecture as well as a number of efficacy studies on

Table 5. Teaching methods and approaches covered in general reviews of research on teaching, per period

	(1980s and 1990s) 14 reviews	(2000s) 12 reviews	(2010s 12 reviews
Overall/generic approaches with societal or humanistic aspirations			Creative learning environments
Overall/generic teaching methods or approaches, or method aspects, explicitly tied to an overall/generic approach	<u>Constructivist-related approaches (5 items):</u> Cooperative, small-group learning (3 items); Reciprocal teaching; Tutoring	<u>Constructivist-related approaches (3 items):</u> Cooperative learning and computer technology; Problem-based learning; Cognitive load theory versus constructivist teaching <u>Cognitive Load Theory-based approaches (3 items):</u> <i>Cognitive load theory versus constructivist teaching*</i> ; The expertise reversal effect; The modality effect; Cognitive load theory and ICT Self-regulated learning (2 items) Learner-centred teacher-student relationships	<u>Constructivist-related approaches (2 items):</u> Discovery based instruction; Scaffolding  Memory research versus conventional instructional strategies  Affective, social and emotional teacher-student relationships (2 items)
Specific method or content aspects	Teacher questioning behaviour; Teaching student to generate questions; Self-questioning instruction Feedback (2 items); Learning skills Problem-solving instruction Teaching of concepts	Formative feedback	

Table 5. (Continued)

	(1980s and 1990s) 14 reviews	(2000s) 12 reviews	(2010s) 12 reviews
Teaching including ICT artefacts		Distance education  <i>Cooperative learning and computer technology; Modality effect; Cognitive load theory and ICT</i>	Virtual-reality- based education (3 items)
	Games for educational purposes	Instructional animation and pictures	The educational potential of robotics in schools Serious gaming (2 items)

\*Italics indicate the second occurrence of a method or approach in the table, as four of them belong to two different categories.

different types of communicative–interactive classroom methods, in particular discovery learning, problem-based learning and inquiry learning. In brief, the review is a strong dismissal of these learner-centred methods: the authors find weak empirical support for the methods and question their theoretical foundation. The outstanding citation record of this review indicates a backlash concerning progressive education in general, or at least for learner-based methods, but that is arguably only partly true. Many of the articles—including a number of the reviews in our corpus—refer to the Kirschner *et al.* (2006) review without agreeing with its conclusions but in fact arguing against them or at least finding them too rigid.

*Post-structuralist science teaching and the various meanings of literacy.* Another distinctive feature in the topical topography of the field is the strong interest in scientific argumentation and conceptualisation reflected in several reviews of research on science teaching. This is especially prominent during the 2000s. Many of these reviews deal with a teaching approach that, from a post-structuralist-influenced point of view, claims the advantages and the necessity of teaching science in a societal context not restricted to ‘pure’ science teaching. Some of the reviewers clearly advocate this socio-scientific teaching approach. However, whereas post-structuralist- and constructivist-related reviews are common in the sample of science teaching reviews, those perspectives are, with one distinct exception (a review exploring research on language, identity and social change), absent in reviews of research on language teaching. Language reviews generally explore narrow curricular aspects within language teaching, mainly reading comprehension, usually by comparing two or more methods of instruction within a specific domain with the aim to conclude which alternative has the strongest empirical support. The language teaching reviews are, as we

Table 6. Teaching methods and approaches covered in reviews of research on language and literature teaching, per period

	(1980s and 1990s): 4 reviews	(2000s): 5 reviews	(2010s): 8 reviews
Overall approaches with societal or humanistic aspirations			L2 learning, identity and social change
Overall teaching methods or approaches, or method aspects, explicitly tied to an overall approach	L2 instruction	L2 instruction	L2 instruction; L2 instruction with ICT
Specific method aspects	<u>Reading comprehension (2 items):</u> Reading comprehension instruction; Vocabulary instruction	<u>Reading comprehension (4 items):</u> Reading comprehension instruction of students with learning disabilities; Tutoring programs for students with reading difficulties; Phonemics and phonics instruction (2 items)	<u>Reading comprehension (5 items):</u> Academic vocabulary learning as a language acquisition tool; Morphological instruction and literacy skills; Naming speed and reading; Writing instruction and reading comprehension
Teaching including ICT artefacts	Writing: Composition teaching		<i>L2 instruction with ICT*</i>

\*Italics indicates the second occurrence of one approach that belongs to two categories.

will come back to, generally meta-analyses oriented towards quantitative data, in sharp contrast to the science teaching reviews.

The way different reviews define literacy illustrates this contrast between reviews of research on science and those on language teaching. Language literacy, in our sample, is mainly restricted to the ability to read and write, to acquiring basic language skills. With the exception of the review mentioned above, it is not about understanding and affecting the social world. When literacy is addressed in the science teaching reviews, its definition is wider and generally more or less explicitly related to either post-structural theory or constructivism. According to such definitions, science literacy is primarily the ability to understand scientific language and the natural science processes for which the language is used. In addition, it is often seen as including the ability to understand and debate the role of science in society—its environmental impact, its relation to power and economics, and so on. Only one general review in the sample deals with teaching from a similar, wider, societal or humanistic perspective. That review summarises research on creative learning environments, focusing on the aesthetic aspects of schooling.

Table 7. Teaching methods and approaches covered in reviews of research on science and mathematics teaching, per period

	(1980s and 1990s) 7 reviews	(2000s) 8 reviews	(2010s) 6 reviews
Overall approaches with societal or humanistic aspirations		<u>Scientific literacy</u> (3 items): Scientific argumentation teaching; Science literacy; Informal reasoning regarding socio-scientific issues	<u>Scientific literacy</u> : Arguments to foster scientific literacy
Overall teaching methods or approaches, or method aspects, explicitly tied to an overall approach	<u>Constructivist-related approaches</u> (5 items): Integrated perspectives in science instruction and learning; Scientific discovery learning with computer simulations of conceptual domains; Laboratory instruction styles; Conceptual change in science teaching	<u>Constructivist-related approaches</u> (2 items): Laboratory instruction; Conceptual change in science teaching	<u>Constructivist-related approaches</u> (3 items): Inquiry-based science teaching (2 items); Learning science through research apprenticeships
Specific method aspects	Use of concept maps in science assessment Functions, graphs and graphing in mathematics teaching and learning	Self-regulation and meta-cognition in science education Teachers' use of mathematics curricula Mathematical interventions for children with special needs	
Teaching including ICT Artefacts	* <i>Scientific discovery learning with computer simulations of conceptual domains</i>		Computer simulations in science teaching (2)

\*Indicates second occurrence of one approach in the table that belongs to two categories.

*The digital breakthrough of the 2010s.* Finally, one obvious and new feature in the research landscape on teaching is the breakthrough for reviews of research on ICT-related teaching methods and approaches in the 2010s (9 out of 15 reviews in total).

These reviews address digitally assisted teaching and learning, following a rapidly moving technological challenge to traditional schooling. ICT in education has become more and more a focus of researchers and reviewers, though researchers report very mixed results when it comes to the educational outcomes of ICT. It is also worth noting that research and reviews in this field, with their potential to fundamentally alter the teacher–student relation, clearly reflect the aforementioned tension between research based on constructivist theory and research based on other, more neuroscience-oriented cognitive theories such as cognitive load theory. Whereas about one-third of ICT reviews clearly uphold a constructivist position, another third is clearly tied to cognitive-load theory or related theoretical strands. The theoretical underpinnings of the remaining third are more implicit.

*Review topics summary.* The review topics concern many different teaching methods and approaches in K-12 schools, either as general/generic phenomena or by exploring research on subject-specific teaching. General reviews concern a variety of aspects of teaching and learning more or less tied to specific teaching methods and usually building on some kind of psychology-derived learning theory. Many of these reviews assess constructivist teaching, which clearly ties in to the perennial dispute regarding the student-centred versus teacher-centred learning dichotomy and the efforts to dissolve it (see e.g. Elen *et al.*, 2007). The subject-specific reviews belong to two subject domains (science and mathematics, and language) reflecting the strong emphasis on these subjects in educational research and policy, not least manifested in the PISA tests (Pereyra *et al.*, 2011). The reviews of research on science teaching clearly deviate from those on language teaching. Relatively broad constructivist or post-structuralist approaches to teaching are common in the science reviews, whereas language reviews mainly are meta-analyses, assessing research on rather narrow aspects of language teaching. In addition, ICT as a teaching necessity is treated in many reviews, both general and subject-specific. This ICT breakthrough belongs to the twenty-first century—following a fast-growing digitalisation of society—and rather starkly illustrates the challenges of producing solid and practically useful evidence in research syntheses (Polanin *et al.*, 2017). Many of the ICT reviewers stress the uncertainties involved in measuring the educational effects of various digital resources, given their novelty and the lack of empirical studies. It is thus questionable whether ICT in teaching is yet an appropriate target for second-order evidence-based research.

*Review context: Knowers and arenas in research reviews on teaching*

WoS is a collection of databases that has been criticised for being biased towards science and engineering at the expense of the humanities and social sciences and, moreover, for favouring US research and thus research in English (Mongeon & Paul-Hus, 2016). These facts partly explain the composition of the collection of authors and journals represented in our sample.

*Multiple authorship and varying author experience.* In total, the 75 reviews include 212 authors, of which 200 are different individuals, as eight researchers are authors in two separate reviews, and two researchers are authors in three separate reviews. Two

relevant authorship aspects concern the number of authors involved in a review and their research experience. The number of authors involved in a review seems to increase over time. One out of two reviews has more than two authors, and reviews with more than two authors are more frequent over time (see Table 8). The average number of authors per review increases from 2.32 in the first period (1980s and 1990s) to 2.72 in the 2000s and 3.44 in the 2010s sample. On average, there are more authors involved in general reviews compared to subject-specific reviews (3.11 authors per review versus 2.54). In the 1980s and 1990s period, single authors or pairs of authors produce two-thirds of the reviews. In the 2010s, two-thirds of the reviews have more than two authors. Two reviews in the corpus have as much as nine listed authors. The increase in multiple authorship (three or more authors) arguably indicates that the collective research production machinery typical for science and medicine has influenced education research and perhaps review making in particular.

When it comes to research experience, a substantial share of authors have long or quite long experience: 129 authors earned their PhDs at least five years before the time of the review, whereof 98 had at least ten years of professional (i.e. post-PhD conferral) research experience (see Table 9). The author stock also includes a substantial share of fresh researchers (29 authors) and contributors without PhDs (54 authors). The latter group includes a diverse set of contributors, either on their way to earning a PhD or working as research assistants of various sorts. The research assistants belong to reviews with four or more authors. The composition of the multiple authorships is thus another indication of review production in the style of science, where a group of researchers with different levels of experience and skills and different kinds of expertise cooperate, in many cases including PhD students and their supervisors. This leads to the question of which author has the main review responsibility. Who is in charge?

Often, the first-mentioned author is the one most responsible for a journal article. This does not always have to be the case (like in the 17 reviews where the authors are presented in alphabetic order), but we would argue that ‘first author’ generally indicates a special authorship responsibility. Consequently, a substantial share of first authors in the sample (see Table 10) are experienced researchers. Two-thirds of the review sample (51/75) have first authors with at least five years of professional research experience, of which the majority (38/75) have at least ten years of experience. For the less-experienced first authors—the remaining one-third—the review is connected to their PhD projects, either as a follow-up study (within a few years after earning their PhDs) or within an ongoing project. In these cases, they generally have at least one or two experienced researchers as co-authors (of which one or both could be supervisors), with a view to ensuring acceptable quality. In a number of reviews, the main contribution of certain co-authors has clearly been to assist as methodological or technological consultants, that is, to provide review-method expertise, especially for conducting meta-analyses.

Finally, some remarks on the gender distribution between male and female authors, which is fairly even. Men make up 53% (113 of 212) of the authors. Male authors are slightly more common in the first period (1980s and 1990s) and in the third (2010s) and clearly more common in the 2000s. The predominance of male authors is a bit more pronounced among first authors. In each period, 14 of the 25 reviews have a

Table 8. Number of authors per review and period

Number of authors per review	1980s and 1990s	2000s	2010s	
One author	8	7	2	17
Two authors	8	6	7	21
Three authors	4	6	4	14
Four authors	4	4	7	15
Five authors	0	0	3	3
Six authors	1	1	1	3
Nine authors	0	1	1	2
Total	25	25	25	75

male first author. There are no significant gender differences concerning research experience or multiple authorship. With regard to topics, however, there are quite distinct gender imbalances, with more male reviewers of research on general teaching (61 out of 112 authors) and on science teaching (30 out of 48) and more female reviewers of research on language teaching (27 out of 47). In all, the gender distribution among the authors arguably shows that educational research has been comparatively gender-balanced over time, but with substantial variations within its different sub-fields, explained by authors' ties to different academic disciplines. Men, for instance, have held a significantly stronger position in math-intensive research fields compared to other fields (Hur *et al.*, 2017).

*Origins of the reviewers: North American dominance.* WoS is located in the USA, and North America dominates when it comes to the national affiliations of the authors (see Figure 5). Three-quarters of all authors are affiliated with institutions in the USA (57%) or Canada (17%). The final quarter (26%) are affiliated with institutions in nine other countries: four European (the Netherlands, the United Kingdom, Germany and Greece), three Asian (Taiwan, Israel and Hong Kong), plus Australia and Brazil. It is also worth noting that the US affiliations include institutions in more than 30 US states, with Illinois, California and Connecticut having at least 10 contributing authors per state. This indicates that education review research is not concentrated in

Table 9. Length of authors' research experience

All authors	1980s and 1990s	2000s	2010s	Total
25 years or more as a PhD	10	16	14	40
10–24 years as PhD	17	14	27	58
5–9 years as PhD	8	11	12	31
1–4 years as PhD	10	6	13	29
PhD the same year	1	4	2	7
PhD 1–4 years after the review	5	4	11	20
PhD 5 years or more after the review	0	6	1	7
No PhD	7	7	6	20
Total	58	68	86	212

Table 10. Length of first authors' research experience

First authors	1980s and 1990s	2000s	2010s	Total
25 years or more as a PhD	4	5	6	15
10–24 years as PhD	9	6	8	23
5–9 years as PhD	5	5	3	13
1–4 years as PhD	6	5	5	16
PhD the same year	0	1	0	1
PhD 1–4 years after the review	1	2	3	6
PhD 5 years or more after the review	0	1	0	1
No PhD	0	0	0	0
Total	25	25	25	75

a limited number of strong research environments within the USA but extends nationally.

The decades of the twenty-first century have a higher international distribution of authors compared to the decades of the twentieth, as illustrated in Figure 6, which displays the national distribution of first authors. Researchers affiliated with the USA or Canada are first authors in 23 of the 25 reviews in the first period, but in the 2000s and 2010s, a third of the first authors are affiliated with countries outside of North America: 9 out of 25 in the 2000s and 8 out of 25 in the 2010s.

The affiliation patterns are similar concerning the scholarly training of the review researchers (Figure 7). Of the 192 authors with PhDs earned before or after their review contributions, 110 completed their doctoral education in US universities, 34 in Canadian universities, 34 in universities in Europe, and the final 14 in universities in Asia (Taiwan, Hong Kong, Israel or Japan), Australia, or Brazil. At a national level in the USA, California universities (particularly Stanford) stand out, contributing 22 researchers with PhDs.

*Reviewer expertise: Educational psychologists, review makers and topical investigators.* Table 11 provides a rough estimation of the research disciplines the review producers represent. Disciplinary background has been estimated by using author presentations and additional information concerning PhD theses, research CVs, and so on. In many cases, the disciplinary boundaries are blurred, and many of the researchers are tagged with more than one discipline tag. Whether all the different categories qualify as academic disciplines is debatable, but the category serves the purpose of distinguishing the academic variation. Digital learning and education, for instance, is a rather special research interest within disciplines such as educational psychology, research on science teaching, or computer science.

Many different disciplinary and sub-disciplinary domains are represented, but educational psychology stands out as the strongest domain, especially among the general review authors. Many of them (75 of the 192 authors with PhDs) identify themselves with educational psychology and/or have earned their PhDs within that discipline. Educational psychology has held a strong position within the Anglo-American sphere of education research, particularly within the field of systematic research reviews.

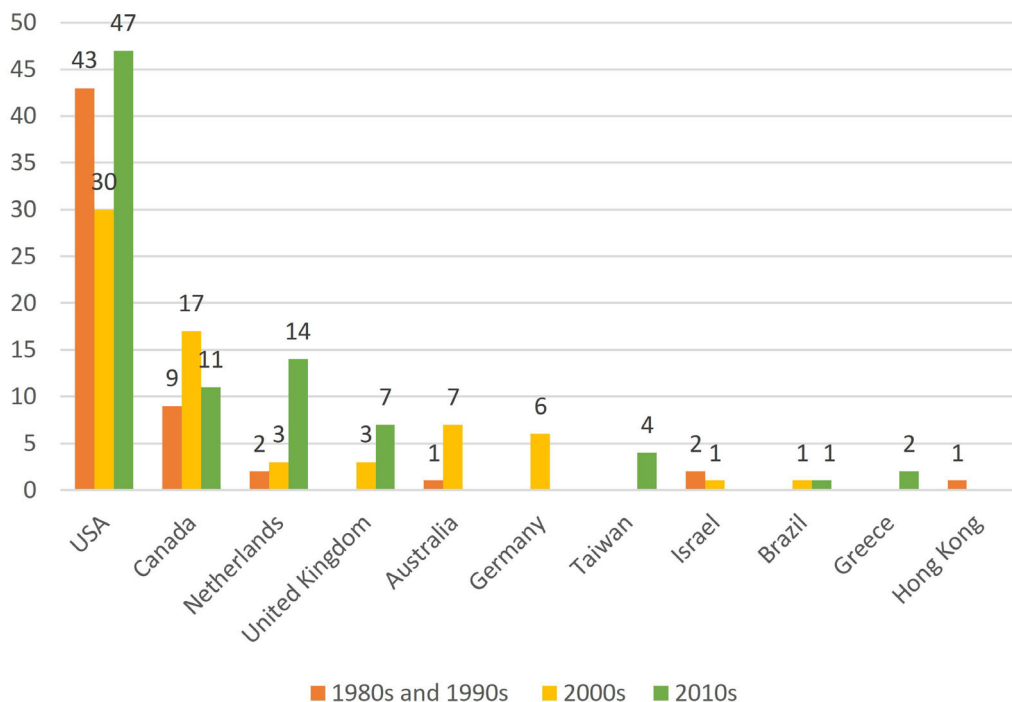


Figure 5. National affiliations of all authors

The predominance of the field of psychology among the researchers who produced the general reviews in our corpus—a group of reviews that almost exclusively consists of quantitative meta-analyses or mixed systematic reviews—arguably explains their affinity for evidence-based, medicine-related methodology and lines of reasoning. Worth noting, however, is that applied linguists and language educators are the main producers of subject-specific meta-analyses (as most of the language teaching reviews are quantitative studies), whereas science education researchers (including some with subject-specific, non-education PhDs) are the main producers of qualitative reviews. In addition, the growing research on digital resources for teaching in the 2010s has introduced computer science as a discipline involved in education research and review. As Table 11 shows, 32 of 80 authors in the 2010s perform research on digital resources. Some are computer scientists, while others are researchers in education or educational psychology or in science or language teaching.

This leads to the most important author aspect: their degrees of expertise. We would clearly state that all the reviews include expert authors, though the types of expertise involved vary between and within reviews. In most cases, the review includes at least one author—usually the first author—with topical expertise, or expert knowledge about the teaching in question, generally including an invested research interest in exploring, developing and promoting/defending either a particular instructional method or approach or a more generalised theoretical perspective on learning.

Another type of expertise that is prominent in many reviews is the review-method expertise of performing systematic reviews, especially when it comes to meta-

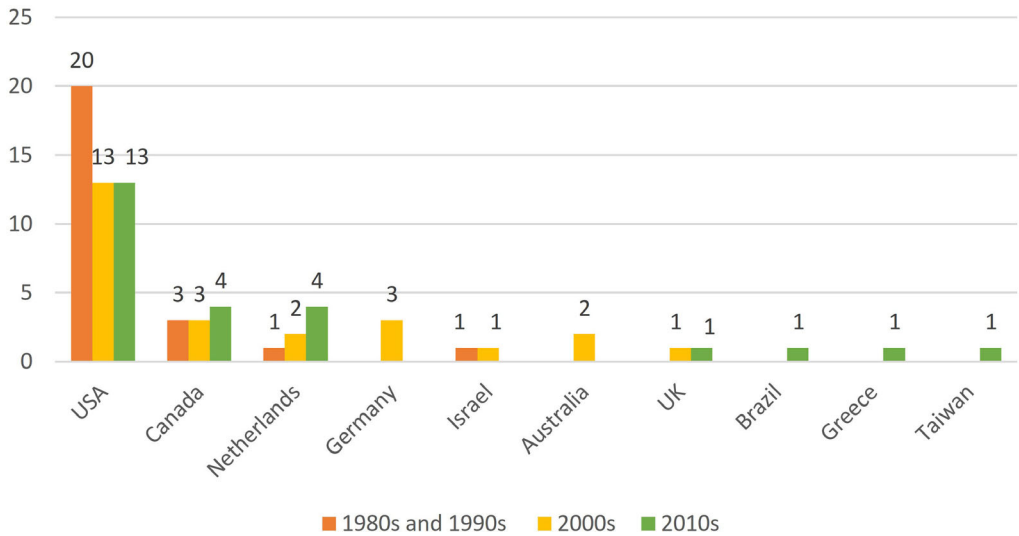


Figure 6. National affiliation of first authors

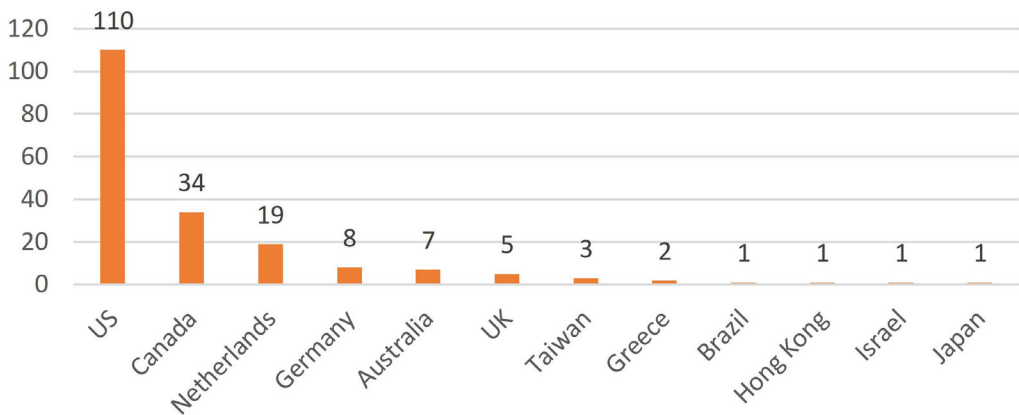


Figure 7. Countries where authors with PhDs earned their doctoral degrees

analyses. Some first authors seem to possess both types of expertise, but review-method expertise often seems to be a task for assisting authors. Gene Glass is a good example to illustrate this phenomenon. Glass is a co-author of a comparative meta-analysis on science and literature instruction research from 1993. He is also a recognised statistics specialist and the one said to have coined the term *meta-analysis*. His main contribution to the 1993 review was clearly to ensure an accurate methodology. In a small number of reviews in our corpus, the technical review-method expertise overshadows topical expertise, at least according to the research record of the first authors and the reviewers’ ways of addressing the topic under enquiry. In addition, the broad range of topical expertise led to variable distances from teaching and learning as a school discipline among the researchers.

Table 11. Disciplinary belonging of the review authors with PhDs before or after review publication, per period

Disciplinary tag	1980s and 1990s	2000s	2010s
Educational Psychology and Psychology	25	20	30
Education	9	9	12
Digital Resources in Education	8	10	32
Computer Science and Education	1	2	6
Science and Education	12	20	21
Mathematics and Education	1	4	1
Language and Education	10	17	20
Literature and Education	1	0	0
Humanities and Education	1	0	1
Social Sciences and Education	0	0	2
Special Education	2	9	2
Total number of discipline tags	70	91	130
Total number of PhD Authors	51	61	80

The interest in school practice in the review sample varies, and we would say that this variation partly corresponds to author expertise and disciplinary background. Whereas some reviews—most subject-specific reviews and some general reviews—target the classroom or other alternative educational settings as the context for the teaching and learning under scrutiny, other reviews are less concerned with educational practices. In these cases, the research referred to, as well as the review itself, are produced in a more narrow research context.

*The review arenas: Six domains, with US dominance in five.* The journals in which the 75 reviews were published belong to roughly six disciplinary domains: education in general, educational psychology, teaching in science and language, information and computer technology as educational tools (ICT in education), and special education (Table 12). As Table 12 shows, about half of the reviews (37/75) were published in general education journals, whereas 10 reviews were published in psychology journals. The most prominent journal is clearly *Review of Educational Research*, a journal tied to the US organisation AERA. It is open to a wide range of contributions but has a strong affinity for educational psychology. In addition, our sample includes reviews from five science-education and four language-education journals, three ICT journals and one journal on special education, while none of the journals or the reviews included relate to the humanities, the social sciences, the arts, physical education, and so on. This could be due to the limitations of WoS but also to the fact that there is a relatively low number of research reviews within those subject areas and, in all, weaker financial and administrative support for research in those areas. Also worth noting is the US dominance, congruent with the aforementioned author distribution. Sixty reviews were published in journals based in the USA. The only domain where US journal contribution is absent is ICT in education, a domain that partly defines the 2010s period. Ten out of 15 reviews that appeared in non-US journals were

published (in Europe or Australia) in the 2010s, indicating less US domination in recent years.

*Review context summary.* The reviews are carried out by varying numbers of researchers, but multiple authorships with at least three authors are more common over time. Research experience also varies, but in general at least one author, often the first author, has a fairly long or very long research record. In all, there is a strong but slightly diminishing North American dominance concerning the journals publishing the reviews and the review authors' research schooling and professional affiliations. Besides a clear male dominance concerning first authorship, female authorship is as common as male authorship. The disciplinary backgrounds of review authors and review journals confirms that educational psychology generally holds a strong position, specifically with regard to the general reviews, whereas subject specialists generally perform the subject-specific reviews. In most cases, a review includes at least one author with topical expertise, and many reviews, primarily meta-analyses, include at least one author with review-method expertise. The topical experts generally have an invested research interest vis-à-vis the reviewed teaching method or approach.

## **Conclusions and implications**

The aim of this overview has been to describe and analyse the review topography of prominent second-order research on teaching (RQ1) and to trace patterns of stability of change in that topography (RQ2). We have done so by mapping the most-cited reviews of research on teaching in Web of Science during the past four decades. The mapping through the lens of research reviews lead us to some summarising and concluding remarks, and a number of implications to be drawn. We will first outline the main features of this selected review topography and then discuss some implications of our findings, mainly concerning review making in the field of research on teaching. Finally, we argue for how our type of overview may contribute to educational research.

### *Five concluding remarks*

1. The dominating research tradition represented in our sample of most-cited reviews of research on teaching is the functionalistic/instrumental tradition, but at the same time, a substantial number of reviews—including many of the most-cited reviews in the corpus—are conceptual and/or originate from interpretative epistemological traditions. This finding shows that the evidence base for teaching is not reducible to reviews primarily concerned with general effect sizes. Research on teaching, when treated as a unity at a secondary level, emerges as a rather open, unstable, and multidisciplinary research field. As such, the knowledge production in terms of research reviews is contingent on external and internal demands. The reviews vary in terms of topics and topical epistemological knowledge boundaries, and there is not a single, agreed-upon foundation for their knowledge production. Rather, they make use of a variety of theoretical/conceptual frameworks, perspectives and review methodologies, and there is no common theoretical language or

Table 12. The publication arenas for the reviews (disciplinary domains, journals and publishers)

Disciplinary domain	Journal	Publisher	1980s and 1990s			Total
			1980s	1990s	2000s	
Education (37)	Review of Educational Research	AERA/SAGE	16	9	5	30
	American Educational Research Journal	AERA/SAGE	2	0	0	2
	*Learning and Instruction	EARLI/Elsevier	0	2	0	2
	Educational Researcher	AERA/SAGE	0	0	1	1
	Harvard Educational Review	Harvard	0	0	1	1
	Thinking Skills and Creativity	Elsevier	0	0	1	1
Educational Psychology (10)	Journal of Educational Psychology	APA	0	1	2	3
	Educational Psychologist	APA/Routledge	0	3	0	3
	Educational Psychology Review	Springer	0	1	1	2
	Contemporary Educational Psychology	Elsevier	1	0	0	1
	Child Development	Society for Research in Child Development (SRCDD)/Wiley	0	0	1	1
Science Education (12)	Journal of Research in Science Teaching	NARST/ Wiley	2	2	2	6
	International Journal of Science Education	Taylor & Francis	0	1	1	2
	Science Education	Wiley	0	2	0	2
	Journal of Chemical Education	Division of Chemical Education of the American Chemical Society	1	0	0	1
	Research in Science Education	Australasian Science Education Research Association (ASERA)/Springer	0	1	0	1
Language Education (8)	Reading Research Quarterly	ILA/Wiley	1	1	2	4
	Language Teaching TESOL Quarterly	Cambridge TESOL International Association/Wiley	0	0	2	2
			1	0	0	1

Table 12. (Continued)

Disciplinary domain	Journal	Publisher	1980s and 1990s			Total
			1980s	2000s	2010s	
ICT in education (7)	Language Learning	Wiley	0	1	0	1
	Computers & Education	Elsevier	0	0	5	5
	Simulation & Gaming	Sage	1	0	0	1
	Computer Assisted Language Learning	Taylor & Francis	0	0	1	1
Special Education (1)	Remedial and Special Education	Hammill Institute on Disabilities/ SAGE	0	1	0	1

\*Shaded areas mark journals published outside of the US.

terminology among all the review researchers. Thus, it is also difficult to predict citation success, as there is no easily identifiable group of scholars (elite) with privileged positions in regard to getting readers and potential citations.

Although meta-analysis is a dominant review format in the sample, it is perhaps less dominant in the twenty-first century than might be expected in an era of evidence-based education. The share of quantitative meta-analyses is rather constant over time. This suggests that, while large-scale meta-analyses and even syntheses of meta-analyses (like Hattie's synthesis of hundreds of meta-analyses, *Visible Learning*, in 2009) have been widely acclaimed in public and political debates on schooling, there is no strict parallel to the world of research. In other words, though the impact of meta-analysis is strong within the education research community, it is perhaps less strong than in many other education arenas. It has not redefined what counts as evidence in research on teaching, but it has induced an increased awareness of systematics.

2. Our findings suggests that educational psychology occupies a dominant position in and partly defines the field of second-order research on teaching. This is hardly a new phenomenon. Educational psychology has been strong in the research field on teaching for a long time, especially in the Anglo-American world. In our sample, the quantitative methodologies of psychology and applied linguistics pervade the general reviews and the reviews on language teaching over time, focusing on estimations of students' performance and cognitive measurement and applying what could be described as typical natural-science methodology most extensively advocated in medical research. The strong, well-established positions of psychology and applied linguistics clearly match the relatively constant presence of meta-analyses in our sample. In contrast, reviews of research on science teaching, where one might expect natural science methodology to dominate, employ many different methodologies, reflecting a methodological variety within that branch of research.
3. Review topics have changed over time in response to internal researcher discussions and knowledge development as well as external social changes; ICT related

to teaching and instruction would be one example. We would argue that most topics in the sample are highly relevant for professionals and policy-makers, although some topics are more academically oriented than others. In any case, we want to stress that both generalists and specialists (within different disciplines and regardless of research tradition) are generally cautious when it comes to recommendations for teachers or policy-makers, avoiding simplistic prescriptions. For instance, our overview points to an endeavour—especially among meta-analysts and systematic reviewers in the functionalist-instrumental tradition—to provide balanced conclusions by addressing issues of context dependence, problems with generalisability, transfer problems, and so on. A crucial aspect of this is the expertise generally involved: most reviews, regardless of format or topic, include at least one reviewer with invested knowledge in the teaching matter at stake.

4. There are distinct variations in how the reviews (and their reviewed research) conceive of and treat teaching, spanning from narrow aspects of specific knowledge acquisition for a defined group of learners to programmatic theories more or less applicable to any teaching–learning situation. We have specifically observed the distinction between general and subject-specific reviews in this overview. We conclude that the core of most-cited reviews of research on science and mathematics teaching differs significantly from most general reviews and reviews of research on language teaching in the corpus. In particular, the community of research on science teaching seems more classroom-oriented and more concerned with teaching as a matter of content, often placed in relation to social conditions. The larger interest among researchers on science teaching for treating teaching, learning and knowledge as social phenomena seems paradoxical. Still, this could be another indicator of the relative strength and autonomy of the natural sciences. Science is more prestigious than other academic disciplines, which may place science-teaching researchers and practitioners at an advantage compared to those engaged in other types of teaching, and manifests a traditional school curriculum hierarchy (Bleazby, 2015). Research on science teaching is, accordingly, a relatively resource-rich subfield in education research that might be open to greater variety in terms of theoretical perspectives, methodologies and topical angles compared to many other subfields of research on teaching.
5. The mapped review topography is not homogeneous, comprising varieties of teaching methods and approaches—some more generic and others more specific with regard to subject-specific content, age and teaching-aspect scope—but there is still a rather constant hegemonic order in the topography with regard to context, methodology and topics:
6. The researchers and the publishing journals mainly belong to the Anglo-American sphere, where educational psychology holds a strong position.
7. The systematic review format, rooted in a functionalist research tradition, and with meta-analysis its most distinct feature, functions as the norm that reviewers in other research traditions increasingly appear to follow.
8. Although the covered teaching methods and approaches are treated as either more or less generic or subject-specific, only three school-subject areas—science, mathematics and language—are actually represented in subjects-specific reviews, and

research on teaching in those three subject areas is also much more common in general reviews compared to research on teaching in other school subject areas.

### *Implications for review making in educational research*

Our mapping analysis, restricted to reviews published in journals, indicates that different types of reviews of research on teaching have become standard references among educational researchers in different sub-fields, with meta-analysis as the single most used review format. In addition, our mapping confirms an increased awareness of conducting and presenting reviews in a systematic manner, reflected in an intense production of systematic reviews, not least during the last decade. The demands for accuracy and transparency are fundamental components of primary research, and thus has been a legitimate argument for questioning the credibility of ad hoc reviews, where authoritative expert researchers refrain from reflecting on or presenting their methodological considerations. Still, demands of formality do not guarantee a well-conducted review and in some cases might even cover up poorly conducted primary research while ruling out valuable research due to formal requirements.

The well-established dominance of reviewing from a functionalist perspective in our review topography thus implies that reviews from other theoretical perspectives (in the hermeneutic meaning making or critical-emancipatory research traditions) might too have to adapt to the requirements rooted in functionalism. They are forced, so to speak, in that direction, especially if they want to improve their chances of getting well cited. At the same time, systematic reviews from non-functionalist perspectives, arguably may add a dimension of clarity, which functionalist reviewers often refrain from: explicit argumentation concerning their meta-theoretical points of view in relation to the research and the teaching under scrutiny. Critical Construct Synthesis (CCS) introduced by Wolgemuth *et al.* (2017) is a recent example of this type of merger. CCS is a critical systematic review format, aiming to ‘unpack assumptions in research synthesis and to show how other framings of educational problems are made possible when the constructs excluded through methodological elimination decisions are taken into consideration’ (Wolgemuth *et al.*, 2017, p. 131).

The review topography also implies that the growth of review making in research on teaching has increased the tensions between generalisation and specialisation at different levels, due to the hegemony of the topography (as sketched above). The Anglo-American dominance and the strong impact of educational psychology, functionalist research methodologies and some specific school-subject areas undoubtedly reflect dimensions of research strength, largely representing a strong aim for increased generalisation and standardisation. English is the preferred academic language; many universities and academic journals from the USA are internationally renowned; psychology has gained recognition for its aspirations to conform to the scientific demands of the natural sciences; and science, mathematics and language regularly are put forward as key school subjects. However, this hegemony simultaneously reflects a certain decontextualised narrowness, which in turn may affect the production and dissemination of research on teaching worldwide, as well as education policy and practice on a global scale. While the tension between generalisation and specialisation

is an inherent aspect of making reviews, one implication of the present study is that this tension should be given more explicit attention in future reviews of research on teaching. The quest for generalisation in the review topography, with its increased emphasis on systematically reviewable research, thus has led to an absence of certain research on teaching. The weak representation in our sample of research on teaching perspectives, taking into account contextual factors such as national and cultural differences, student group varieties or dealing with content within subject areas other than science, mathematics and language, suggest that such research is underused in systematic reviewing in the functionalist research tradition.

Science, language and mathematics teaching in our corpus of research stands out as the most prominent subject-specific teaching. Science teaching in particular is the kind of teaching from which generic teaching principles often are derived in reviews with general teaching claims: reviews evaluating constructivist methods, for instance, mainly refer to research on science teaching. This implies a dubious reliance on science teaching serving as a generic model for all teaching, at the same time confirming and refining an established school curriculum hierarchy (Bleazby, 2015). Somewhat paradoxically, however, some of the more eager contesters of generic teaching models seems to act within research on science teaching. Thus, the implication is not as clear-cut as one might expect. Our analysis points to an ambiguity in this respect, as reviews of research on science teaching on the one hand seem like a deviation from the hegemonic norm, as many of these reviews embrace research that tackle teaching with qualitative means and use theories tied to critical-emancipatory or hermeneutical knowledge traditions. On the other hand, the community of second- and first-order researchers on science teaching could be regarded as a norm-breaker from within, holding a strong research position due to the disciplinary knowledge and/or background, enabling maverick behaviour.

### *The potential merits and limitations of overviews*

Finally, we want to argue for the necessity for carrying out our type of overview of educational research, as a complementary and challenging alternative to other types of overviews. The overview is an emerging field of research wherein syntheses of meta-analyses dominate almost exclusively. In contrast, the present study allows for an openness to different methodological approaches, reflecting the scope of research being done in the field, rather than what a subset of researchers with a particular orientation believe the top priority should be. It is important to map and analyse the methodologies, topics and contexts in a field of research to complement a narrower focus on effectiveness. We argue that the present study illustrates the fruitfulness of a topographic overview approach, as it yields several interesting findings. In fact, it seems difficult to discuss a research field if we lack knowledge about its topography. It should be stressed that the ultimate interpretation of such topographies is closely tied to the methodological approach advocated by the analyst or the reader. Thus, from a critical perspective, we would find the lack of critical reviews contributing to the topography very worrying, whereas, from a functionalist point of view, we might see the heterogeneity of the field as grounds for concern.

Third-order overviews have been introduced as a response to the powerful expansion of second-order reviews of research. Still, overviews of secondary research are arguably open to criticism for sharing and even increasing some of the weaknesses associated with reviews of primary research. Overviews, even more than reviews, represent a quest for extracting the current state of research in a particular field—but at the risk of abstraction, misinterpretation and oversimplification. A more specific objection to our type of overview might be that it is futile to combine loosely connected and partly unrelated research branches in the multi-faceted field of research on teaching. This is a relevant objection but, paradoxically, also a compelling argument for performing more overviews in this style. Overviews that include varied research arguably work as complementary and critically challenging alternatives to the kind of overview syntheses presented by Polanin *et al.* (2017).

Hattie's *Visible Learning* (2009) stands as the most prominent example of a prescriptive overview so far in education research. The book builds on more than 800 meta-analyses in order to provide informed and compelling prescriptions regarding what makes the best teaching. It has arguably had significant impact on research, policy and practice regarding teaching, as its very high GS citation record indicates (again, 16,482 hits as of 12 August 2020, while omitted in WoS). It comprises a different kind of handbook from the ones described before (such as the AERA handbook of research on teaching) in that it explicitly defines optimal teaching according to sound research evidence. Critics, however, have pointed out several weaknesses of this influential meta-meta-research. *Visible Learning*, in particular, has been a target because of its significant, worldwide impact on policy and practice, as manifested in a number of international, national and local policy programmes directly or indirectly supervised or influenced by Hattie. The criticism is that the prescriptive conclusions are unconvincing and contestable because the synthesis methodology employed ignores the challenges of aggregating effect sizes from meta-analyses and validating the quality of underlying primary and second-order studies (cf. Terhart, 2011; Simpson, 2019; Gorard *et al.*, 2020). Other critics emphasise that *Visible Learning* and, even more so, the education programmes that emanate from it represent the essence of decontextualised and programmatic evidence-based educational policy and practice (cf. Eacott, 2017; McKnight & Whitburn, 2018/2020).

The issue of decontextualisation, we would stress, is very crucial in relation to both second-order reviews and third-order overviews. Efforts to summarise evidence on teaching run the risk of being counterproductive due to the reductions of teaching context and content required in the process. The non-prescriptive overview model introduced here (tentatively applied to a body of most-cited reviews in WoS) emphasises the importance of context at many different levels: research context as well as the context and content of teaching. The expanding efforts to review and overview what research knows about teaching (or any other aspect of education) is legitimate, but it requires a sophisticated awareness of the inherent limitations of any such project. Overviews considering context contribute to that awareness.

In all, similar points made regarding relevant reviews may apply to relevant overviews in our fashion: they provide synoptic and integrative meta-meta-perspectives on research branches that have become disconnected, though they share a familiar research object such as teaching. We suggest that our type of overview, with its efforts

to identify, explore and characterise a relatively wide second-order topography, and considering both temporal and spatial dimensions, is synoptic and integrative in that sense.

The present study is thus a first step to developing a more inclusive orientation towards research overviews. We have chosen to analyse reviews from WoS for reasons stated prior in this article. There are several possible routes to increase our knowledge about reviews of teaching. While the present study, by design, provides a topography of only the most-cited reviews in WoS, further studies can investigate the ways in which the empirical patterns revealed here resemble those of a representative sample of all reviews of teaching in Web of Science, without regard to number of citations. Moreover, mappings and analyses of high-impact reviews of teaching in Google Scholar can be carried out, with the caveats discussed earlier in this article in mind. These types of analyses can be compared to the topography of the original research in order to provide important knowledge about the ways in which reviews reflect the underlying field of original research. If we conceive of research about teaching as a ship travelling across the ocean, it would seem to be very important to know the exact position of the ship in order to navigate it in the right direction. The methodologies, topics and contexts of the research are surely important in narrowing down the exact position. This study could work as a starting-point for such a systematic endeavour.

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### **Conflict of interest**

The authors report no conflict of interest.

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### **Ethical approval**

As this article reports a scoping overview study, no participants were involved and an ethical review was not required.

### **Data availability statement**

The data set used is available at the Web of Science citation database: [apps.webof-knowledge.com](https://apps.webof-knowledge.com).

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# Appendix 1

Review title	Authors	Journal	Publication Year	Topic	Type of review	Range/type of teaching	Addressing special education or ICT	Age group	Number of studies	Citations	
										Web of Science (2018-06-01)	Web of Science (2020-03-13)
1 The teaching of concepts: a review of instructional-design research literature	Tennyson, RD; Park, OC	Review of Educational Research	1980	Teaching of concepts	Theory and research review	General		Undef.	81	82	251
2 A meta-analysis of experimental research on teacher questioning behavior	Redfield, DL; Rousseau, EW	Review of Educational Research	1981	Teacher questioning behaviour	MA	General		20	112	131	566
3 Educational outcomes of tutoring: A meta-analysis of findings	Cohen, PA; Kulik, JA; Kulik, CLC	American Educational Research Journal	1982	Tutoring	MA	General		65	480	523	1923
4 Does 2nd language instruction make a difference: A review of research	Long, MH	TESOL Quarterly	1983	Second language instruction	MA	Language		15	161	177	1185
5 Implications of cognitive theory for instruction in problem solving	Frederiksen, N	Review of Educational Research	1984	Problem-solving instruction	Theory and research review	General		Undef.	150	155	700
6 What works in teaching composition: A meta-analysis of experimental treatment studies	Hillocks, G	American Journal of Education	1984	Composition teaching	MA	Language		60	108	120	550
7 Self-questioning instructional-research: A review	Wong, BYL	Review of Educational Research	1985	Self-questioning instruction	Theory and research review	General		27	112	123	435
8 A review of research on formal reasoning and science teaching	Lawson, AE	Journal of Research in Science Teaching	1985	Formal reasoning in science teaching	Theory and research review	Science		Undef.	110	116	311
9 The effects of vocabulary instruction: A model-based meta-analysis	Stahl, SA; Fairbanks, MM	Review of Educational Research	1986	Vocabulary instruction	MA	Language		54	322	365	1492

## Appendix 1 (Continued)

Review title	Authors	Journal	Publication Year	Topic	Type of review	Range/type of teaching	Addressing special education or ICT	Age group	Number of studies	Citations		
										Web of Science (2018-06-01)	Web of Science (2020-03-13)	Google Scholar (2020-03-13)
10 Learning and instruction: an examination of 4 research perspectives in science education	Eylon, BS; Linn, MC	Review of Educational Research	1988	Integrated perspectives in science, instruction and learning	Theory and research review	Science		Y1- university	20	158	169	572
11 Functions, graphs, and graphing: Tasks, learnings, and teaching	Leinhardt, G; Zaslavsky, O; Stein, MK	Review of Educational Research	1990	Functions, graphs and graphing in math teaching and learning	Research review	Mathematics		Age 9-14	Undef.	317	403	1498
12 The instructional-effect of feedback in test-like events	Bangertdrowns, RL; Kulik, CLC; Kulik, JA; Morgan, M	Review of Educational Research	1991	Feedback	MA	General		Y1- university	39	413	487	1662
13 Moving from the old to the new: Research on reading-comprehension instruction	Dole, JA; Duffy, GG; Roehler, LR; Pearson, PD	Review of Educational Research	1991	Reading comprehension instruction	Research synthesis	Language		All	Undef.	246	276	1392
14 The effectiveness of games for educational purposes: A review of recent research	Randel, JM; Morris, BA; Wetzell, CD; Whitehill, BY	Simulation & Gaming	1992	Games for educational purposes	Research review	General	ICT	Y1-12	67	234	286	1104
15 Promoting conceptual change in science: A comparative meta-analysis of instructional interventions from reading education and science-education	Guzzetti, BJ; Snyder, TE; Glass, GV; Gamas, WS	Reading Research Quarterly	1993	Conceptual change in science teaching	MA	Science		Y1-12	23	144	195	651
16 Restructuring the classroom: Conditions for productive small groups	Cohen, EG	Review of Educational Research	1994	Cooperative learning	Research review	General		Y1- university	Defined	765	859	3250
17 Reciprocal teaching: A review of the research	Rosenshine, B; Meister, C	Review of Educational Research	1994	Reciprocal teaching for cognitive reading comprehension strategies	Mixed data review	General		Y1- university	16	270	310	1344

Appendix 1 (Continued)

Review title	Authors	Journal	Publication Year	Topic	Type of review	Range/type of teaching	Addressing special education or ICT	Age group	Number of studies	Citations Web of Science (2018-06-01)	Citations Web of Science (2020-03-13)	Citations Google Scholar (2020-03-13)
18 Feedback and self-regulated learning: A theoretical synthesis	Butler, DL; Winne, PH	Review of Educational Research	1995	Feedback and self-regulated learning	Theoretical synthesis	General		Undef.	Undef.	923	1143	3722
19 Effects of learning skills interventions on student learning: A meta-analysis	Hattie, J; Biggs, J; Purdie, N	Review of Educational Research	1996	Learning skills	MA	General		Y1- university	51	309	401	1580
20 Teaching students to generate questions: A review of the intervention studies	Rosenshine, B; Meister, C; Chapman, S	Review of Educational Research	1996	Teaching student-generated questions	MA	General		Y1- university	26	300	360	1241
21 Within-class grouping: A meta-analysis	Lou, YP; Abrami, PC; Spence, JC; Poulsen, C; Chambers, B; d'Apollonia, S	Review of Educational Research	1996	Cooperative learning	MA	General		Y1-12	66	241	283	996
22 Research on cooperative learning and achievement: What we know, what we need to know	Slavin, RE	Contemporary Educational Psychology	1996	Cooperative learning	Theory and research review	General		Y1- university	Undef.	524	606	2303
23 Problems and issues in the use of concept maps in science assessment	Ruiz-Primo, MA; Shavelson, RJ	Journal of Research in Science Teaching	1996	Use of concept maps in science assessment	Research review	Science		Indirect (y6- university)	16	284	320	1079
24 Scientific discovery learning with computer simulations of conceptual domains	de Jong, T; van Joolingen, WR	Review of Educational Research	1998	Scientific discovery learning with computer simulations of conceptual domains	Theory and research review	Science		Undef.	Undef.	506	600	1967
25 A review of laboratory instruction styles	Domin, DS	Journal of Chemical Education	1999	Laboratory instruction styles: expository, inquiry, discovery, and problem-based	Theory and research review	Science		Undef.	Undef.	235	274	810

## Appendix 1 (Continued)

Review title	Authors	Journal	Publication Year	Topic	Type of review	Range/type of teaching	Addressing special education or ICT	Age group	Number of studies	Citations	
										Web of Science (2018-06-01)	Web of Science (2020-03-13)
26 Establishing the norms of scientific argumentation in classrooms	Driver, R; Newton, P; Osborne, J	Science Education	2000	Scientific argumentation teaching	Theory and research review	Science		Undef.	702	847	3109
27 Effectiveness of L2 instruction: A research synthesis and quantitative meta-analysis	Norris, JM; Ortega, L	Language Learning	2000	L2 instruction	Research synthesis and quantitative meta-analysis	Language		All	71	585	2577
28 How effective are one-to-one tutoring programs in reading for elementary students at risk for reading failure? A meta-analysis of the intervention research	Elbaum, B; Vaughn, S; Hughes, MT; Moody, SW	Journal of Educational Psychology	2000	Tutoring programs, students with reading difficulties	MA	Language	Special ed.	K-6	29	207	794
29 Phonemic awareness instruction helps children learn to read: Evidence from the National Reading Panel's meta-analysis	Ehri, LC; Nunes, SR; Willows, DM; Schuster, BV; Yaghoob-Zadeh, Z; Shanahan, T	Reading Research Quarterly	2001	Phonemic awareness instruction	MA	Language		K-2	52	539	1927
30 Teaching reading comprehension strategies to students with learning disabilities: A review of research	Gersten, R; Fuchs, LS; Williams, JP; Baker, S	Review of Educational Research	2001	Reading comprehension instruction to students with learning disabilities	Research review	Language	Spec. ed.	All	Undef.	270	1192
31 Systematic phonics instruction helps students learn to read: Evidence from the national reading panel's meta-analysis	Ehri, LC; Nunes, SR; Stahl, SA; Willows, DM	Review of Educational Research	2001	Systematic phonics instruction	MA	Language		K-2	38	261	1041
32 Small group and individual learning with technology: A meta-analysis	Lou, YP; Abrami, PC; d'Apollonia, S	Review of Educational Research	2001	Cooperative learning, computer technology		General	ICT	Y3 - university	222	265	891

Appendix 1 (Continued)

Review title	Authors	Journal	Publication Year	Topic	Type of review	Range/type of teaching	Addressing special education or ICT	Age group	Number of studies	Citations Web of Science (2018-06-01)	Citations Web of Science (2020-03-13)	Citations Google Scholar (2020-03-13)
33 The expertise reversal effect	Kalvuga, S; Ayres, P; Chandler, P; Sweller, J	Educational Psychologist	2003	The expertise reversal effect	Theory and research review	General		Undef.	Undef.	624	Undef.	Undef.
34 Conceptual change: A powerful framework for improving science teaching and learning	Duit, R; Treagust, DF	International Journal of Science Education	2003	Conceptual change in science teaching	Theory and research review	Science		Undef.	Undef.	354	431	1607
35 Regulation of motivation: Evaluating an underemphasised aspect of self-regulated learning	Wolters, CA	Educational Psychologist	2003	Self-regulated learning and motivation	Theory and research review	General		Undef.	Undef.	254	305	976
36 Mathematics interventions for children with special educational needs: A meta-analysis	Kroesbergen, EH; Van Luit, JEH	Remedial and Special Education	2003	Mathematical interventions for children with special needs	MA	Mathematics	Spec. ed.	K-6		197	248	801
37 Examining the literacy component of science literacy: 25 years of language arts and science research	Yore, LD; Bisanz, GL; Hand, BM	International Journal of Science Education	2003	Science literacy	Research review	Science		Undef.	Undef.	192	230	693
38 Problem-based learning: What and how do students learn?	Hmele-Silver, CE	Educational Psychology Review	2004	Problem-based learning	Theory and research review	General		K-university	Undef.	1056	1408	4768
39 The laboratory in science education: Foundations for the twenty-first century	Hofstein, A; Lunetta, VN	Science Education	2004	Laboratory instruction	Research review	Science		Secondary school	Undef.	575	773	2683
40 How does distance education compare with classroom instruction? A meta-analysis of the empirical literature	Bernard, RM; Abrami, PC; Lou, YP; Borkowski, E; Wade, A; Wozeny, L; Waller, PA; Fisct, M; Huang, BR	Review of Educational Research	2004	Distance education	MA	General	ICT	All	232	389	483	1974

## Appendix 1 (Continued)

	Review title	Authors	Journal	Publication Year	Topic	Type of review	Range/type of teaching	Addressing special education or ICT	Age group	Number of studies	Citations		
											Web of Science (2018-06-01)	Web of Science (2020-03-13)	
41	Informal reasoning regarding socio-scientific issues: A critical review of research	Sadler, TD	Journal of Research In Science Teaching	2004	Informal reasoning regarding socio-scientific issues	Research synthesis	Science		Y3 - university	13	324	400	1293
42	Examining key concepts in research on teachers' use of mathematics curricula	Remillard, JT	Review of Educational Research	2005	Teacher use of mathematics curricula	Research review	Mathematics		K-12	<70	340	447	1318
43	Meta-analysis of the modality effect	Gunns, P	Learning and Instruction	2005	Modality effect, cognitive load	MA	General	ICT	All	43	191	223	558
44	Why minimal guidance during instruction does not work: An analysis of the failure of constructivist, discovery, problem-based, experiential, and inquiry-based teaching	Kirschner, PA; Sweller, J; Clark, RE	Educational Psychologist	2006	Constructivist teaching approaches vs cognitive load theory	Theory and research review	General		Undef.	Undef.	1641	2191	6984
45	Promoting self-regulation in science education: Metacognition as part of a broader perspective on learning	Schraw, G; Crippen, KJ; Hartley, K	Research in Science Education	2006	Self-regulation and meta-cognition in Science	Theory and research review	Science		Undef.	Undef.	275	388	1414
46	Learning with concept and knowledge maps: A meta-analysis	Nesbit, JC; Adesope, Olusola O	Review of Educational Research	2006	Concept and knowledge maps	MA	General		Y4- university	55	255	324	1029
47	Instructional animation versus static pictures: A meta-analysis	Hoeffler, TN; Leutner, D	Learning and Instruction	2007	Instructional animation	MA	General	ICT	K-university	26	286	390	934
48	Learner-centered teacher-student relationships are effective: A meta-analysis	Cornelius-White, J	Review of Educational Research	2007	Learner-centred teacher-student relationships	MA	General		K-university	119	286	428	1574
49	Focus on formative feedback	Shute, VJ	Review of Educational Research	2008	Formative feedback	Research review	General		All	141	846	1177	3471

Appendix 1 (Continued)

Review title	Authors	Journal	Publication Year	Topic	Type of review	Range/type of teaching	Addressing special education or ICT	Age group	Number of studies	Citations Web of Science (2018-06-01)	Citations Web of Science (2020-03-13)	Citations Google Scholar (2020-03-13)
50 How can primary school students learn self-regulated learning strategies most effectively? A meta-analysis on self-regulation training programmes	Dignath, C; Buettner, G; Langfeldt, HP	Educational Research Review	2008	Self-regulated learning training programmes in primary education	MA	General		K-6	30	192	267	791
51 Scaffolding in teacher-student interaction: A decade of research	van de Pol, J; Volman, M; Beishuizen, J	Educational Research Review	2010	Scaffolding	Theory and research review	General		Undef.	66	179	313	1038
52 Recent research on human learning challenges: conventional instructional strategies	Rohrer, D; Pashler, H	Educational Researcher	2010	Recent human learning research and conventional instructional strategies	Theory and research review	General		Undef.	Undef.	89	120	301
53 Inquiry-based science instruction-what is it and does it matter? Results from a research synthesis years 1984 to 2002	Minner, DD; Levy, AJ; Century, J	Journal of Research in Science Teaching	2010	Inquiry-based science teaching	Research synthesis	Science		K-12	138	275	455	1543
54 Learning science through research apprenticeships: A critical review of the literature	Sadler, TD; Burgin, S; McKinney, L; Pontuan, L	Journal of Research in Science Teaching	2010	Learning science through research apprenticeships	Critical review	Science		7-university	53	92	143	335
55 Argument to foster scientific literacy: A review of argument interventions in K-12 science contexts	Cavagnetto, AR	Review of Educational Research	2010	Arguments to foster scientific literacy	Research review	Science		K-12	54	96	118	356
56 The effects of morphological instruction on literacy skills: A systematic review of the literature	Bowers, PN; Kirby, JR; Deacon, SH	Review of Educational Research	2010	Morphological instruction and literacy skills	MA	Language		K-8	22	140	200	468
57 Interactions between type of instruction and type of language feature: A meta-analysis	Spada, N; Tomita, Y	Language Learning	2010	Language instruction types	MA	Language		Undef.	30	137	206	600

## Appendix 1 (Continued)

Review title	Authors	Journal	Publication Year	Topic	Type of review	Range/type of teaching	Addressing special education or ICT	Age group	Number of studies	Citations	
										Web of Science (2018-06-01)	Web of Science (2020-03-13)
58 Naming speed and reading: From prediction to instruction	Kirby, JR; Georgiou, GK; Marinussen, R; Parrila, R	Reading Research Quarterly	2010	Naming speed and reading	Theory and research review	Language		Undef.	Undef.	104	144
59 The impact of enhancing students' social and emotional learning: A meta-analysis of school-based universal interventions	Weissberg, RP; Durlak, JA; Dymnicki, AB; Taylor, RD; Schellinger, Kriston B.	Child Development	2011	Social and emotional learning interventions	MA	General		K-12	213	1201	1880
60 The influence of affective teacher-student relationships on students' school engagement and achievement: A meta-analytic approach	Roorda, Debora L.; Koomen, Helma.MY; Spilt, JL; Oort, FJ	Review of Educational Research	2011	Affective teacher-student relationships	MA	General		K-12	61	313	542
61 Does discovery-based instruction enhance learning?	Alferi, L; Brooks, PJ; Aldrich, NJ; Tenenbaum, HR	Journal of Educational Psychology	2011	Discovery based instruction	MA	General		K-university	164	198	326
62 Educational virtual environments: A ten-year review of empirical research (1999-2009)	Mikropoulos, TA.; Natsis, A	Computers & Education	2011	Educational virtual environments	Systematic review	General	ICT	K-12	53	108	219
63 Writing to read: A meta-analysis of the impact of writing and writing instruction on reading and social change	Graham, S; Hebert, M	Harvard Educational Review	2011	Writing instruction and reading comprehension	MA	Language		Y1-12	95	88	154
64 Identity, language learning, and social change	Norton, B; Toohey, K	Language Teaching	2011	Second language learning, identity and social change	Critical review	Language		Undef.	Undef.	135	198
65 Experimental and quasi-experimental studies of inquiry-based science teaching: A meta-analysis	Furtak, EM; Seidel, T; Iverson, H; Briggs, DC	Review of Educational Research	2012	Inquiry-based science teaching	MA	Science		K-12	37	131	236

Appendix 1 (Continued)

Review title	Authors	Journal	Publication Year	Topic	Type of review	Range/type of teaching	Addressing special education or ICT	Age group	Number of studies	Citations Web of Science (2018-06-01)	Citations Web of Science (2020-03-13)	Citations Google Scholar (2020-03-13)
66 Our princess is in another castle: A review of trends in serious gaming for education	Young, MF; Slota, S; Cutler, AB; Jalette, G; Mullin, G; Lai, B; Simeoni, Z; Tran, M; Yukhymenko, M	Review of Educational Research	2012	Serious gaming	Research review	General	ICT	K-university	39	183	272	675
67 Exploring the educational potential of robotics in schools: A systematic review	Vavassori Benitti, FB	Computers & Education	2012	The educational potential of robotics in schools	Systematic review	General	ICT	K-12	10	126	251	732
68 The learning effects of computer simulations in science education	Rutten, N; van Joelingen, WR; van der Veen, JT	Computers & Education	2012	Computer simulations in science teaching	Systematic review	Science	ICT	Age 12-20	51	176	276	687
69 Computer simulations to support science instruction and learning: A critical review of the literature	Smetana, LK; Bell, RL	International Journal of Science Education	2012	Computer simulations in science teaching	Critical review	Science	ICT	K-university	61	94	144	404
70 Words as tools: Learning academic vocabulary as language acquisition	Nagy, W; Townsend, D	Reading Research Quarterly	2012	Academic vocabulary learning as a Language acquisition tool	Theory and research review	Language		K-12	Defined	129	217	641
71 A meta-analysis of the cognitive and motivational effects of serious games	Wouters, P; van Nimwegen, C; van Oostendorp, H; van der Spek, ED	Journal of Educational Psychology	2013	Serious games—cognitive and motivation	MA	General	ICT	All	38	246	411	1081
72 Current status, opportunities and challenges of augmented reality in education	Wu, HK; Lee, SWY; Chang, HY; Liang, JC	Computers & Education	2013	Augmented reality	Theory and research review	General	ICT	All	54	221	414	1209

## Appendix 1 (Continued)

Review title	Authors	Journal	Publication Year	Topic	Type of review	Range/type of teaching	Addressing special education or ICT	Age group	Number of studies	Citations		
										Web of Science (2018-06-01)	Web of Science (2020-03-13)	
73 Creative learning environments in education-A systematic literature review	Davies, D.; Jindal-Snape, D; Collier, C; Digby, R; Hay, P; Howes, A	Thinking Skills and Creativity	2013	Creative learning environments	Systematic review	General		K-12	210	84	143	404
74 Effectiveness of virtual reality-based instruction on students' learning outcomes in K-12 and higher education: A meta-analysis	Merchant, Zi; Goetz, ET; Cifuentes, L; Keeney-Kennicutt, W; Davis, JJ	Computers & Education	2014	VR-based instruction	MA	General	ICT	K-university	69	96	269	703
75 Technologies for foreign language learning: A review of technology types and their effectiveness	Golonka, EM; Bowles, AR; Frank, VM; Richardson, DL; Freynik, S	Computer Assisted Language Learning	2014	Foreign language assisting technology	Research review	Language	ICT	Undef.	350	109	185	585