Improving second language reading comprehension through reading strategies

A meta-analysis of L2 reading strategy interventions

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Effective readers consciously or unconsciously use reading strategies to help them process information on what they read. All readers can benefit from reading strategy instruction but, empirical research on which strategies are effective is lacking. Less is known about reading strategy effectiveness in a second language (L2). This meta-analysis of 46 L2 reading strategy studies analysed ten reading strategies, also in combination with a range of pedagogical approaches, and found an overall mean effect size of *0.91,* underscoring the benefits of multi strategy teaching. Effect sizes were calculated for each strategy, as well as the combination of strategy with approach, instructor type, intervention duration and type of test used. Some strategies were more effective than others. Also, differences in effect sizes are dependent on the approach used. Some pedagogical approaches are effective for some strategies but not with all. We recommend further research in L2 reading strategy interventions and instruction.

Keywords: L2, reading strategies, meta-analysis, intervention, education

1. Introduction

As soon as we are able to read by ourselves we start to become independent acquirers of information, making the ability to read, perhaps, one of the most important cognitive skills we will ever master (Ali & Razali, 2019). While we read we construct meaning from the text by connecting the unfamiliar to that which is already familiar, hence, acquiring new information and knowledge (Bimmel, van den Bergh, & Oostdam, 2001). Therefore, the transition from learner reader

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to reader learner (Wigfield, Gladstone & Turci, 2016) is an important one, as skilled readers can construct meaning from the written text (Anderson, Reynolds, Scallert & Goetz, 1976). Being in control of one's own learning forms a crucial step in our own cognitive development (Paris & Paris, 2001).

Once a child becomes independent in their reading, the young reader will develop their reading skills and strategies further to enable them to learn faster and help them achieve their academic goals (Enright, Grabe et al., 2000). The concern is whether students have achieved effective and efficient reading skills by the time they exit (formal) education (Chall, Jacobs et al., 2009). Students in full time education who experience difficulties in comprehending complex and detailed study texts, may have not yet developed the sophisticated reading comprehension skillset, that these texts require in order to be understood sufficiently (Lee & Spratley, 2010). Furthermore, these students may be unaware of the relationship between their metacognition, and its crucial role in monitoring their reading comprehension (Solórzano-Restrepo & López-Vargas, 2019).

The ability of reading comprehension can be defined as the purposeful application of a set of complex cognitive processes, skills, and strategies that combine in such a way as to enable the reader to comprehend textual information, and to interpret it accordingly (Grabe & Stoller, 2020; Hedgcock & Ferris, 2018; Koda, 2005). A study by the International Association for the Evaluation of Educational Achievement found that secondary school children were likely to be at a disadvantage in subjects such as science and mathematics, if they lacked effective reading skills, as all subjects are effectively text based. Their conclusion was that better readers outperformed lesser readers with similar mathematical and scientific ability, according to the relationship report on reading, mathematics and science achievement (IMSS & PIRLS, 2011). As a result, policy makers have endeavoured to enhance teaching and learning in mathematics, however, without improvement in reading comprehension skills there will be limited benefit (Cohen & Ball, 1990). Furthermore, students who have experienced difficulties with their reading comprehension, upon entering higher education, may find themselves unable to meet the substantial reading demands that their studies entail, which in turn, could lead to an unnecessary prolongation or at worst, to complete their studies (Kordes, Bolsinova, Limpens & Stolwijk, 2013; Dreyer & Nell, 2003). Vocabulary and comprehension, have been long neglected subjects of instruction in the primary grades and still appear to be neglected in secondary and higher education (Duke & Block, 2012).

Reading strategies are defined intrinsically as the conscious and unconscious steps readers take to correct and improve their comprehension of written text (Oxford, 2016) which can be both deliberate and goal-driven (Yang, 2006), Reading strategies have been described as an ongoing "inner conversation" which helps

the reader decide between what is important, and unimportant (Allen, 2003, p. 320). Furthermore, pertinent from the longitudinal study of Van Gelderen et al. (2007) is the importance of teaching meta-cognitive reading strategies (Pinninti, 2016) in order to consciously repair faulty comprehension by employing compensatory reading strategies while being supported and facilitated by the teacher of the class (Macaro, 2001). Indeed, most reading strategy instruction includes some form of focus on meta-cognition, if only to create more awareness of one's reading behaviour and comprehension pitfalls (Macaro & Erler, 2008).

Fully informed awareness instruction, in the form of metacognitive instruction, has been found to result in higher reading performance than non-informed meta-cognitive instruction (Aghaie & Zhang, 2012). Informed instruction would involve teaching the purpose of reading strategies as well as their application, because when readers are more aware and are informed of the goals, process and purpose behind reading strategies they are more able and likely to duplicate the reading behaviour of proficient readers. In this way, the why, and how of applying strategies forms the knowledge that acts as an 'adhesive', affixing skill and will together (Teng, 2020).

A proficient and effective reader possesses the ability to unconsciously and effectively applying reading strategies when necessary in a rapid, frequent, efficient, and fluid fashion at any point during the reading process (Anderson, 2004; Yoshikawa & Leung, 2020.; Hassan, 2017). However, less effective readers may find that reading strategies can play a contributory role in the development and acquisition of successful reading skills (Cain, Oakhill, & Bryant, 2004; Cho, Afflerbach & Han, 2018; Pressley & Afflerbach, 1995; Wu, 2016). Moreover, students who are in possession of a range of strategic reading skills seem to be more successful in expanding and organising their learning via their reading (Huang & Chang, 2019). Given our current reliance on technical appliances such as computers and mobile devices in educational settings combined with the text-based nature of all academic subjects, it is fair to assume that we are likely to make even greater, rather than lesser, demands on our abilities in reading (Grabe & Stoller, 2020).

Meta-analytical studies of first language (L1) reading interventions, such as Grabe and Stoller (2011), have pointed to the beneficial effects of teaching reading strategies on L1 reading comprehension performance. In these meta-analyses an overall effect size was applied to indicate effectiveness. Rosenshine, Meister, and Chapman (1996) meta-analysed 26 studies in which L1 students were taught the cognitive reading strategy of asking oneself questions while reading, with overall effect size results of .36 and .86 using standardised tests and non-standardised tests, respectively. Berkeley, Scruggs and Mastroplieri (2009) analysing 70 interventions of content area instruction for students with mild to severe learning dis-

abilities in which L1 reading strategies as well as information technology (IT) skills were included, and found a large overall effect size of 1.00.

As citizens of the world become multi-lingual, second language (L2) proficiency in a commonly used second languages, such as English, is in great demand in areas such as science, technology, and research, as well as many other professional and social communication forms of information transfer. Scientific journals and articles, for example, are increasingly written and consulted in a second language (Grabe & Stoller, 2011) making it more and more necessary to be able to read at a high level of proficiency in one's L2, which requires a considerable resource from reading in one's L1 (Bernhardt, 2011). Whereas, English has, to a large extent, been adopted as the lingua franca of the academic, scientific and global communicative community, it is important for this group that L2 reading research should not be confined to English only but to many second languages offered in an L2 curriculum (Hinkel, 2011), as appreciation of other languages helps lower barriers, eases communication internationally and may bring cognitive benefits to the learner (Reiche, Neeley, & Overmeyer, 2017).

When we consider the issues with reading in L2, we realise that L2 reading difficulties are as diverse and urgent as the reading concerns in the L1 (Alderson, 2000; Yoshikawa & Leung, 2020; Kato, 2018). Longitudinal studies such as Van Gelderen et al., (2007) demonstrate that the differences between reading in one's L1 and L2 are both significant and varied (Gorsuch & Taguchi, 2008; Kamil, 1995). Moreover, the range of L2 language proficiencies differs more widely than in L1, the student may or may not have acquired tacit L1 experience in their reading, which in turn may either offer support or interfere with their L2 reading development (Grabe & Stoller, 2011). Discussions on the issue of L2 reading transfer focuses on the fact that skill transfer cannot be considered to be automatic (Duke, Pearson, Farstrup & Samuels, 2002). Furthermore, the L2 reading comprehension process involves the interplay of skills, and knowledge in two languages which will determine such factors as word recognition, reading speed, textual organisation, expectations of success or failure, motivation for reading, and strategies for comprehension (Cook & Bassetti, 2005; Koda, 2007, 2008; Scott & de la Fuente, 2008). Although research into L2 reading has contributed to our understanding of the process of becoming a proficient L2 reader (Harrington, 2018; Koda, 1996) less research has been conducted in the field of L2 reading strategies and specifically L2 reading strategy instruction with regard to its impact on reading comprehension performance (Grabe & Stoller, 2011).

Reading researchers have provided support for the premise that reading strategy instruction can improve L2 reading comprehension performance (Macaro & Erler, 2008; Taylor, Stevens & Asher, 2006). However, where research comes up short in the L2 domain is in the determination of the effectiveness of

the many different and diverse L2 reading strategies and their individual effect on reading comprehension performance (Grabe, 2010). Grabe and Stoller (2011) notes that while much L2 research has centred on which types of reading strategies L2 readers employ, how they are used, and how often they are used (Moktari, Reichard & Sheorey, 2008) we still know very little about which reading strategies work best in improving L2 reading performance, due to a shortage of empirical investigation focusing on different reading strategies and their effectiveness in L2 reading comprehension performance.

Similarly, little analytical research has been carried out at meta-level on the effectiveness of L2 reading strategy instruction. While it is important to examine the quality of studies included in a meta-analysis it is also essential not to draw comparisons between disparate studies where such comparisons may not be warranted (Ellis, 2018). Taylor et al. (2006) meta-analysed the effectiveness of *Explicit Reading Strategy Teaching* (ERST) in 23 L2 reading studies. Students taught with ERST performed better when compared to non-ERST groups. The strategies taught and the type of test administered were found to have an influential effect on the reading comprehension results of the ERST groups, with an overall effect size of *.54*. However, while both cognitive and meta-cognitive strategies were included in the study, the main criterion for inclusion was the comparison of ERST teaching to non-ERST teaching, and no analysis was carried out between the different reading strategies. Hall et al. (2016) took a differential approach, by meta-analysing reading instruction for L2 learners across differing academic contexts, such as social studies, science and mathematics including forty-six L2 studies. Their results suggest the benefit of high impact reading instruction approaches, with an average effect size of *.35* for the experimental groups compared to the control groups. Nevertheless, this study did not compare the effectiveness of different strategies, nor was a distinction made between the various strategies. Furthermore, the scope of academic subjects included was broad, while the inclusion criteria were rigorous: The intervention duration was set at a minimum of 10 sessions, students were required to be in school grades from four to eight, and only studies from the USA were selected. The last criterion excludes the current diversity of reading strategy research being undertaken around the globe, which is something this current meta-analysis has tried to address.

The L2 meta-analyses outlined here have contributed to the field in terms of the importance of L2 strategy teaching, and reading strategy awareness. However, none of the above mentioned studies compared the effectiveness of individual L2 reading strategies while assessing their influence on L2 reading comprehension. This present meta-analysis is an attempt to fill this gap by testing the effectiveness of individual reading strategies, and their effect on L2 reading comprehension performance. Furthermore, as there seems to be no specification of L2 reading

strategy methods created for adolescents and older students, we modified a number of reading strategies from the general reference reading strategy handbook of Harvey and Goudvis (2007).

Cognitive strategies which utilise an interactive and conscious process between reader and text, for example, the reading strategy of connecting new information to what is already known or the strategy of making predictions while reading (Pickering & Gambi, 2018), bear similarities to the strategy of asking questions while reading, where the reader's attention is directed to self-questioning in response to critical areas of the text (Park & Kang, 2018). Metacognitive strategies such as guessing for meaning and paying special attention to signal words (Taylor, Stevens, & Asher, 2006) are typically strategies that involve a repair-making or problem-resolving action by the readers, for example, when they come into contact with unfamiliar vocabulary or concepts in the text (Khataee, 2019; Pritchard, 1990; Hebert, Zhang & Parrila, 2018). Sinatra and Dowd (1991) suggested that readers employ these strategies when encountering ambiguities in the text to check and correct understanding while establishing textual intrasential and intersential ties (see also Olson & Gee, 1991; Sheorey & Mokhtari, 2008; Sinatra & Dowd, 1991).

While understanding the relevance of reading strategies can prove useful for the independent L2 reader, reading can also be supported by students working with other students in solving reading tasks together (Klinger & Vaughn, 2000). The pedagogical approach of collaborative practice that combines cooperative learning principles together with reading strategy instruction has been found to promote empathy, communication, and bolster problem-solving skills (Chu, Tse & Chow, 2011). Students who regularly work together during reading activities were reported to demonstrate more initiative, and show a stronger work ethic (Linehan & McCarthy, 2001).

Other pedagogical practices, such as the teacher introducing a strategy to the class, modelling aloud how a reading strategy works or individual student practice with reading strategies, are pedagogies that are frequently used as instructional approaches in the reading class, and were examined in this study. Another factor investigated in this analysis was the role of the teacher in the intervention; for example, whether the intervention was conducted by the standard teacher, a non-standard teacher of the class, or by a researcher who was unknown to the students (Wharton-McDonald, 2018). We aimed to determine what influence, if any, these differing instructional approaches could have on L2 reading comprehension performance by isolating different approaches in the reading studies we analysed. The following three research questions guided this meta-analysis:

1. What is the overall effectiveness of reading strategy interventions on L2 reading comprehension performance?
2. To what extent does the type of reading strategy used in the intervention have an influence on student L2 reading comprehension performance?
3. To what degree is the effectiveness of the L2 reading strategy dependent on contextual and educational variables such as teacher type or pedagogical approach used in the intervention?

2. Method

2.1 Search procedures, inclusion and exclusion criteria

We engaged in a step-by-step approach to thoroughly search the literature. First, we compared the search engine Google Scholar with Scopus and Web of Science and found that neither search engine identified more reading strategy studies than Google Scholar. Our first search with this engine used the search terms reading strategies, intervention, L2, reading comprehension, which resulted in 64,200 reading strategy studies. We decided to narrow our search to studies published between 2000 and 2017 after consulting the systematic review of Bimmel, van den Bergh and Oostdam (2001) which included studies up until 2000. The review of Bimmel et al. can be regarded as an objective measurement for L2 studies before 2000. For this reason we decided to limit our search to studies published from this year and we were subsequently able to identify 17,800 potential publications.

Our next step was to hone in on reading strategy studies aimed at L2 reading comprehension by narrowing the range of our descriptors to: *reading strategies, study, Language Learner L2, reading comprehension*. This combination of descriptors located 5,390 publications. By refining our descriptors even further to the combination of: *reading strategies, Language Learner L2, study,* we limited our yield to 4,992 possible studies. By adding an additional descriptor of: *secondary school education* and/or *higher education* to those previously described we reduced our yield further to 1412 studies. We added these descriptors in order to discount studies with young children, because at primary school L1 plays a greater role in reading studies and formal L2 instruction is mostly introduced at secondary school or at least not until the later stages of primary school. We did allow studies with students from age 11–12 years and above, as this would be the most likely age at which students would be introduced to formal second language learning. The 1412 studies we had retrieved were then scanned at abstract level. Potential studies were retained for further screening if they included all of the following inclusion criteria:

1. The study measured the effects of reading strategy instruction with the direct aim of the intervention being to improve L2 reading comprehension.
2. The methodology of the study incorporated either an experimental or a quasi-experimental design, either with separate experimental and control groups or a within groups design in which experimental conditions were compared.
3. Participants must be old enough to receive formal second language education, (normally from 12 years) which discounted early to middle primary education but included late primary and secondary education.
4. A minimum of one session or one week of formal reading strategy instruction must have been given in order for the L2 reading strategies to be tested.
5. The dependent measure(s) generated quantitative data of reading comprehension performance, either from a standardised test, (i.e. Cambridge ESOL, TOEFL, CELDT, MAP, etc.) or a non-standard reading comprehension test. The data provided from the test must be sufficient in order to calculate a weighted effect size in the form of Cohen's *d*.[1]

Next, a search by hand was carried out of author bibliographies, which we scoured for additional reading studies; this search yielded three studies with six databases that had not been found during our initial search. This was followed by a search by hand of journals frequently cited during the database search. This search included: *Journal of Second Language Studies, Review of Educational Research, Reading Research Quarterly, Language Teaching Research, Reading Psychology, Journal of Research in Reading, Research in the Teaching of English, Reading in a Foreign Language, Reading and Writing Quarterly, and TESOL Quarterly*. No new studies were identified during this journal search. Concluding our search which had identified 453 studies that seemed to satisfy our initial inclusion criteria, from these studies 393 were eventually excluded, and 60 were retained for more detailed examination. Exclusion was based on one or more of the following exclusion criteria:

1. Studies that were initially included but were later excluded on the basis of missing information ($n = 13$)
2. The item was not an empirical study but a literature review or synthesis of existing reading studies ($n = 27$)
3. The study featured an intervention, but there were no results published in the report ($n = 112$)

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1. Cohen's *d* like Hedges *g* is is a corrected measure of effect size that shows how much one group, i.e. the experimental group, differs from another group, for example, the control. Hedge's *g* and Cohen's *d* are similar measurements of effect size, however, Hedge's *g* uses pooled (weighted) standard deviations, making it a more reliable measure for small sample sizes.

4. Reading strategy instruction was outlined in the introduction, but neither treatment nor testing were described in the method ($n = 52$)
5. Despite a promising abstract, participants of the study were not given either reading strategy instruction or strategy training prior to testing reading comprehension ($n = 86$)
6. The study did not administer a reading comprehension test as quantitative measure, but instead used a questionnaire or qualitative data was featured, for example, interviews or reading strategy feedback ($n = 103$).

From these 60 studies a further 14 studies had to be discounted as the authors were unable to provide the information requested necessary to calculate an effect size. As a result, a total of 46 studies were selected, some of which had more than one data set, resulting in 58 data sets being prepared for coding. An overview of the database search and study selection is presented in the Appendix.

2.2 Coding procedure

We devised an inclusive coding scheme which incorporated study identifiers, study sample and context, research design and measures based on suggestions offered by Plonsky and Oswald (2012). Weighted effect sizes were calculated during the statistical analysis (see 2.3; Calculation of effect sizes). We discovered that while the studies often used different names to describe the reading strategies used in the study, all reading strategies employed in the studies could be successfully distilled into ten core reading strategies, i.e. "a rose by any other name…". The names and descriptions of the ten reading strategies (see list below) were modified from descriptions of reading strategies provided in the reading strategy handbook "Strategies That Work" from Harvey and Goudvis (2007) and also from our literature search of reading strategy studies.

Although the method of Harvey and Goudvis is intended as a method to teach reading strategies to L1 elementary school children, we found their approach in grouping reading strategies to be applicable to L2 reading comprehension in higher forms of education, the reading strategies described in the handbook could be applied, almost universally, as a general frame of reference, to every reading comprehension setting. After making a number of slight modifications to the reading strategies from the handbook, we were able to add these to the most frequently mentioned and used reading strategies discovered during our extensive L2 reading strategy literature search, in order to form a more direct connection with the literature.

Reading strategies and descriptions

1. **Activating background knowledge**: activation of previous knowledge on a subject, for example, mind-mapping, as a means to help support and expand background knowledge.
2. **Guessing meanings from context**: contextual clues in the text are used to guess meanings of a word or phrase and to help build up a picture of the text as a whole.
3. **Semantic mapping**: creating meaning-based connections between words or phrases in the text to help facilitate understanding.
4. **Making predictions while reading**: the reader thinks ahead while reading and predicts outcome and anticipates events in the text, which in turn enables a faster and more efficient reading process.
5. **Visualisation**: creating visual images of what is being read in order to engage more fully with the text.
6. **Skimming and scanning**: Skimming is reading for general gist in order to form a global concept of the text as a whole. Scanning is the search for specific information by ignoring irrelevant parts of the text and concentrating on the parts that deal with that item.
7. **Looking for clues in headings, subheadings and pictures**: gleaning information from headings, subheading and pictures or illustrations to form a coherent concept of the main topic and sub topic of the text.
8. **Connecting new knowledge to what is already known**: attaching new information to what is already known about a subject in order to comprehend and make connections in order to draw inferences in the text.
9. **Asking questions while reading**: adopting an inquisitive frame of mind while reading in order to form a deeper understanding and anticipate outcome.
10. **Paying attention to text structure and signal words:** recognizing and identifying the structure of a text to comprehend the text's internal logic. Being aware of the use and meaning of signal words can help the reader follow the direction of the writer's thoughts.

Added to the coding identifiers we included author, year of publication, whether the study was published or an unpublished thesis or dissertation. The identifiers also included the study context, such as English as a Second Language (ELL), English as a Foreign Language (EFL), school type, number of participants, intervention duration, instructor type, pedagogical approach used, reading test, (standard or non-standard, i.e. self-made), and the mean scores (pre-and post-test) for the control and experimental groups, as well as the standard deviation and weighted effect size(s). Regular meetings between the raters enabled the authors

to discuss potential problems and suggest solutions in order to eliminate any coding problems.[2]

2.3 Calculation of effect sizes

The effect sizes were calculated using Hedges's *g* and were adjusted for the possibility of small subject bias using weighted effect sizes. We calculated Hedges *g* via the website psychometrica[3] by using the control and experimental groups pretest and posttest means, standard deviations, and sample sizes (Morris, 2008). The total number of pretest-posttest data sets with separate control and experimental groups in our sample was 46, whereas the total number of within group data sets in our sample was 12. We will return to this point later in limitations of this study. seven studies had more than one treatment group (see Appendix). We decided not to combine effect sizes within a multiple treatment analysis, but rather to calculate separate effect sizes for each treatment group, as the treatments used in these studies were sufficiently different and diverse to warrant this.

2.4 Main effects analysis and moderator analysis

As the studies in our sample were extremely varied in terms of approach, number of participants and type of intervention, a random effects model was run in order to obtain an overall estimated mean effect size, rather than one true effect size. A random effects model estimates the mean of a distribution of effects, rather than one calculating one true effect size. Observing the large diversity of our sample, we expected little homogeneity between studies. A random effects model was run to test for heterogeneity, as well as to determine total and sampling variability. We ran a moderator analysis in the form of a mixed effects model in order to investigate possible publishing bias, with "publication" as a moderator on all studies. We subsequently applied further mixed effects moderator analyses on factors the ten reading strategies, pedagogical approaches, treatment duration, school type and level. We observed that the more complicated model fits better than the simple

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2. It is worth mentioning that the original coding procedure underwent a number of stages of refinement, for example, in a previous coding phase the reading strategies were divided into four categories; cognitive, compensation, memory (Zhang, 1993) and combined strategies. However, the authors felt that there was insufficient empirical evidence to justify this particular categorisation of reading strategies.

3. The Psychometrica website: Computation of Effect Sizes can be found at https://www.psychometrica.de/effect_size.html

model which allows us to interpret the parameters accordingly, i.e. the effect size for each moderator effect.

2.5 Description of studies included in the meta-analysis

The studies included in this analysis are described in Table 1 (see Appendix). The 46 studies provided us with 6,675 participants in total. 37 data sets used a standard test for assessment, which was in most cases supported by a measure of reliability, such as Cronbach's alpha. 21 data sets used a non-standard test, in which no measure of reliability was provided. 52 data sets were published as an empirical study in a peer reviewed journal, and six data sets were empirical studies featured in unpublished master's theses or doctoral dissertation. 28 interventions were taught by the standard teacher, and 18 interventions featured the non-standard teacher or researcher teaching the intervention. While no differentiation in selection criteria was made between secondary school and higher education studies it is interesting to note that 30 interventions were conducted in secondary school environments and 28 within higher education. 41 interventions used collaborative practice, 45 interventions used self-practice by students, and 40 used modelling as pedagogical approach. Lastly, the effect size in Table 1 (see Appendix) is given as a calculation of Hedges's *g*.

3. Results

The overall effect size for all studies was estimated as $g = .91$ ($se = .17$, $p < .001$). This overall effect size can be interpreted as a large effect (Cohen, 1992), suggesting that the interventions were effective; in other words, the students who participated in an intervention group, outperformed the students in control groups, in terms of reading performance. However, at the same time, we should exercise caution when assuming an overall effect size for all studies, due to the wide variety of focus and approaches in the studies included in our sample; this was confirmed by a test for homogeneity, ($Q = 4483.10$, $df = 53$, $p < .001$), which showed significant heterogeneity amongst our studies.

3.1 Preliminary analysis

Possible publication bias was tested using a mixed-effects analysis, by applying a dummy-variable for studies published in a peer-reviewed journal. Adding the effect of published studies did not improve the fit of the model ($\Delta\chi^2$ (1) = 0.36; $p = .55$). The difference between the effect sizes of unpublished studies did not

differ significantly from the effect size of all published studies; therefore, no detectable publishing bias can be established.

The design of the studies divided into two groups, where one group contained two sub-groups: the studies had either a (quasi) experimental design ($n=21$) or a posttest only or within subject design ($n=25$). Results show that none of the above mentioned design elements influenced the reported effect size ($\Delta\chi^2(1)=0.91$; $p=.33$). Therefore, study design differences do not appear to affect results. Preliminary analysis for all moderators determined that no significant difference in effect size was found between the two language contexts of the study, i.e. whether the study was conducted in an English as a second language (ESL) or English as a foreign language (EFL) context: ($\Delta\chi^2(1)=1.14$; $p=.22$).

We also looked at whether the study was carried out at a secondary school ($n=30$) or in higher education ($n=28$). Results indicate that effect size differs between secondary education and higher education; ($\Delta\chi^2(1)=6.85$; $p=.01$) indicating that the effect size of secondary education exceeds that of higher education: ($\Delta g=0.88$; $se=.35$). When comparing the effect of the teacher in the intervention ($n=30$) to that of the researcher ($n=16$) no significant difference in effect size was found; ($\Delta\chi^2(1)=0.60$; $p=.44$). This was also true for the variable of duration of the study (min. duration: 6 weeks; max. duration: 2 years) as effect size did not appear to be have been influenced by the length in duration of the study: ($\Delta\chi^2(1)=1.01$; $p=.31$).

3.2 Differences in reading strategies

Firstly, by way of an introduction to the effectiveness of the reading strategies we found that making a difference between the reading strategies improved the fit of the model; ($\Delta\chi^2(9)=19.44$; $p=.02$), meaning that not all reading strategies have the same mean effect size. For each strategy a mean effect size was calculated (see Table 1 in Appendix). Our results indicate that the reading strategy *connecting new knowledge to what is already known* appears to be the most effective reading strategy of the ten strategies analyzed; ($g=1.08$). In contrast, the reading strategies *looking at pictures*; ($g=.35$) and *visualization*; ($g=.42$) were not found to be statistically effective for reading comprehension. In studies that incorporated either the reading strategy *looking at pictures* or the strategy *visualization* the average effect size for the experimental condition did not differ significantly from the control. All other reading strategies were effective with significance: *making predictions while reading*; ($g=.64$), *skimming and scanning*; ($g=.64$), *semantic mapping*; ($g=.69$), *guessing meanings from headings and pictures*; ($g=.75$), *paying attention to structure*; ($g=.77$), *activating background knowledge*; ($g=.92$) and *asking ques-*

tions while reading; (g=1.07). The estimated effect sizes, standard error, significance values and confidence intervals are presented in Table 2.

Table 2. Estimated effect sizes of reading strategies (g), standard error (se), significance values (p) and 95% confidence intervals (ci)

				Confidence intervals	
Reading strategies	*g*	*se*	*p*	**-ci**	**ci**
Looking for clues in pictures and headings	.35	.45	.22	−.53	1.23
Visualization	.42	.40	.15	−.37	1.20
Skimming and scanning	.64	.48	.09	−.30	1.58
Making predictions while reading	.64	.26	.01	.13	1.15
Semantic mapping	.69	.28	<.001	.14	1.24
Guessing meanings from headings and pictures	.75	.26	<.001	.24	1.26
Paying attention to structure	.77	.25	<.001	.28	1.26
Activating background knowledge	.92	.24	<.001	.45	1.39
Asking oneself questions while reading	1.07	.20	<.001	.68	1.46
Connecting new knowledge to what is already known	1.08	.27	<.001	.55	1.61

3.3 Pedagogical approaches

Pedagogical approaches are the methods employed by an instructor during the exchange of knowledge and skills, mostly initiated by the teacher in the development of knowledge or skills for/in the student. The type of pedagogical approach can vary in the study analyzed, depending on the nature of the educational interaction. However, typical approaches included introducing the strategies, teacher modelling, strategy awareness raising, collaborative practice, and student self-practice. We did not detect any statistical significance for pedagogical approaches when these moderators were analyzed as main effects: teacher modelling: ($\Delta\chi^2$ (1) = 0.07; p = .80), awareness raising: ($\Delta\chi^2$ (1) = 0.01; p = .94), collaborative practice: ($\Delta\chi^2$ (1) = 0.09; p = .76), introducing strategies: ($\Delta\chi^2$ (1) = 0.00; p = .97), student self-practice: ($\Delta\chi^2$ (1) = 0.27; p = .59). However, when we analyzed the pedagogical approaches in interaction with the reading strategies we found the effects to be dependent not only on the type of reading strategy taught, but also on the interaction with students within the specific intervention program; in other words, the

effectiveness of the pedagogical approach is dependent on which reading strategy is used.

We analyzed the effectiveness of the various pedagogical approaches together with the reading strategies outlined in each study. We began with the approach of teacher modelling ($n = 40$). We analyzed the effect of teacher modelling according to two models: 1. The effect of teacher modelling the strategies is the same for all strategies. 2. The effect of teacher modelling the strategies is not the same for all strategies. Using this approach we found that the following strategies had a positive effect that was significant for teacher modelling; *visualization* ($g = 1.40$, $n = 11$) and *skimming and scanning* ($g = 1.66$; $n = 10$). For these strategies there was a positive effect of teacher modelling when combined with these reading strategies; visualization ($\Delta\chi^2$ (11) = 23.16; $p = .01$), *skimming and scanning*: ($\Delta\chi^2$ (11) = 22.6; $p = .01$). Further, no other reading strategies seemed to be effective in combination with teacher modelling, and five strategies; (*guessing meanings from context, semantic mapping, making predictions while reading, looking for clues in pictures and headings and asking oneself questions*), were observed to have negative effect sizes when analyzed in combination with the strategies.

The combination of reading strategies and awareness raising of strategies ($n = 41$) was not statistically effective with any of the strategies ($\Delta\chi^2$ (11) = 16.04; $p = .14$). The combination of reading strategy and approach of introducing the strategy ($n = 40$) was found to be effective for one reading strategy: *semantic mapping* ($g = 3.64$); $se = 1.82$), the other combinations of reading strategy and introducing the strategy were not found to be significantly effective. We found that the combination of reading strategies with student self-practice with strategies ($n = 45$) was not statistically effective as an approach, ($\Delta\chi^2$ (1) = 1.10; $p = .29$).

Lastly, we analyzed the reading strategies with collaborative practice between students as a key element in the instruction ($n = 41$) using the same approach as with teacher modelling. We found that only one strategy was statistically effective with this approach; connecting new knowledge to what is already known ($g = 1.61$; ($\Delta\chi^2$ (19) = 37.33; $p = .001$). As an approach, collaborative practice between students requires much practice and the necessary conditions that need to be present in order to work together might not always be available. We observed that in studies where collaborative practice, was featured and where the focus was on reading strategies in which it was indicated that collaborative practice was a key element of the delivery, these studies did not significantly outperform control groups, ($\Delta\chi^2$ (11) = 14.24; $p = .21$).

3.4 Contextual variables of teacher type and test

Next we tested whether the effect of use of standard tests over non-standard tests would differ according to which reading strategy is taught. However, we could not show a significant difference in effect size ($\Delta\chi^2$ (9) = 15.21; p = .09). Nevertheless, we did note that the use of standard tests in interventions tended to lead to smaller effect sizes and the use of non-standard tests in an intervention resulted in significantly larger effect sizes (g = 1.28; se = .27).

The effect sizes of standard (n = 38) and non-standard teacher (n = 20) depended on which strategies were used in the intervention. Statistically significant different effect sizes were detected between the standard teacher of the class and the non-standard teacher of the class teaching the intervention ($\Delta\chi^2$ (11) = 25.12; p < .01). In other words, there is a difference if the standard teacher or the non-standard teacher teaches the intervention, when the standard teacher teaches the intervention this reduces the effect size (g = –.70; se = .35). The differences in effect sizes of standard and non-standard tests and standard and non-standard teachers will be explored further in the discussion.

The effect of the standard versus the non-standard teacher of the class, in interaction with the reading strategies, was analyzed further. For this, we again used two models; we found the model where the effect of the standard teacher differed between strategies to be the better fit: ($\Delta\chi^2$ (11) = 40.4; p < .001). We observed that there is more variation in effectiveness of reading strategies when there is a non-standard teacher teaching the intervention, and that the standard teacher lowers the effect size of the reading strategies somewhat, The combination of the following reading strategies with the non-standard teacher resulted in large effect sizes: *connecting new knowledge to what is already known*; (g = 5.58), *activating background knowledge*; (g = 2.63) and *making predictions while reading*; (g = 1.29).

We observed that the model where the effect of the standard teacher differed between strategies is the best fit for our analysis; however, we surmise that our results may have been influenced by the presence of heterogeneity in our sample. This conjecture was confirmed by a homogeneity test of the last model which indicated that there was significant residual heterogeneity in the sample (QE = 256.97, df = 26, p < .0001). To complete our investigation, we inspected our funnel plot (see Figure 1) to identify possible outliers that could be a potential source of heterogeneity. A funnel plot is a scatterplot of the intervention effect against a measure of study size. In the funnel, the residuals of the model with the strategy categories, and, for example, the standard teacher as explanatory variables are plotted against the standard error. The funnel lines represent the region in which 95% of the studies are expected, in the absence of homogeneity. We observed that while most of the studies were clustered around the overall aver-

age effect size of *0.91* and scattered within the funnel lines, some studies were not. This confirmed our assumption that while there was at least some heterogeneity in our sample, a small number of studies ($n=5$) were outliers and were located outside the lines of the funnel plot. In order to identify which studies were outliers we created a forest plot (see Appendix). A forest plot presents the effect sizes on the *x* axis with the studies (author and date) on the *y* axis. The effect sizes plotted bisect the (symmetrical) bar, which represents the 95% confidence interval (CI). Our forest plot identified five studies to be outliers; Mc Neil, (2011): $g=5.7$, Mc Neil, (2011): $g=4.2$, Hind, (2016): $g=5.3$, Mozafari et al., (2016): $g=3.2$, and Gurk et al., (2016): $g=3.6$.

All five of these outliers exhibited an effect size larger than could be expected from the model. In the study of Hind, where an effect size was reported of *5.3*, a self-made oral reading test was designed and implemented by the researcher which may have contributed to this larger effect size, as self-made tests tend to produce larger effect sizes than normally to be expected (Riffert, 2005). The large effect size of Mozafari et al., of *3.2* could possibly be explained by the fact that the researchers used the results from a complete set of tests from a *Cambridge Preliminary English Test* (PET) in order to homogenize the participants into two groups. In this case, reading, writing and speaking scores from the PET tests were used to calculate a pretest and posttest score which may have contributed to the large effect size. The large effect sizes of McNeil's studies of *5.7* and *4.2* may be attributed to the fact that a teacher made non-standard test was used. We found that when non-standard tests were used it resulted in significantly larger effect sizes (see Contextual variables of teacher type and test). In the case of the study of Gurk et al., (2016) where an effect size of *3.6* was reported, no obvious identifying cause could be found for this outlier.

To this end, we were unable to identify one common cause for these five outliers which may explain their result. We are aware of the fact that with a relatively small sample of studies, such as in this analysis, there is a hypothetical possibility of encountering larger effect sizes, which may or may not be achieved as a coincidental result. Moreover, we had established that there was a significant difference in effect size between the moderators standard and non-standard tests, which may have contributed to some extent to the outlier effect. Thus, in the absence of proof of publication bias and other mentioned variables, we must conclude that the reason might be due to the above mentioned factors, but also, may be due to otherwise hitherto unknown study characteristics, which these studies do not have in common with the other studies in our analysis.

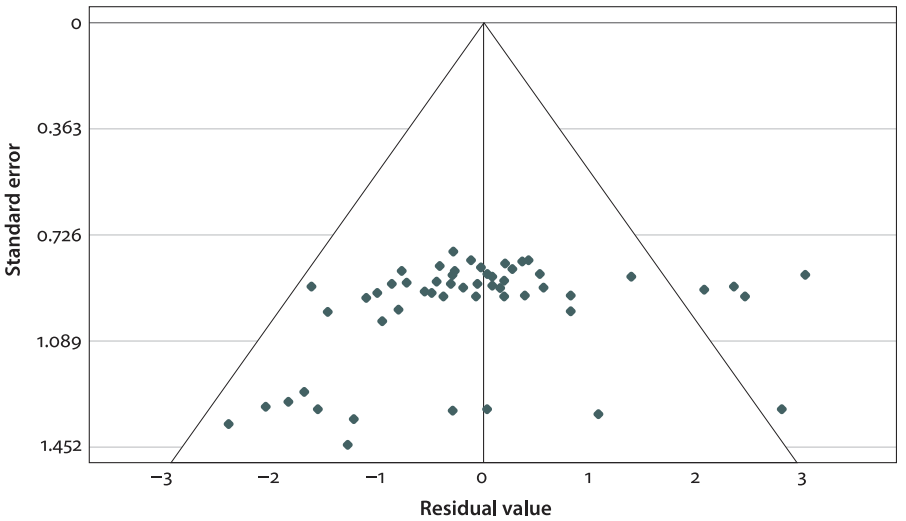

Figure 1. Funnel plot of treatment effect against study measures

4. Discussion

The aim of this meta-analysis was to determine the overall effectiveness of L2 reading strategy interventions and to identify which reading strategies were the most effective in improving L2 reading comprehension. This investigation examined the effectiveness of different intervention features and hoped to pinpoint those which might specifically aid L2 reading performance. Our intention is to discuss our findings in what Plonsky and Oswald term a "meaningful" way (Plonsky & Oswald, 2012, p. 286). It should be noted, however, that meaningfulness should not be perceived as interchangeable for effect size, as not all large effect sizes represent a meaningful result; likewise, not all small effects are devoid of meaning (Prentice & Miller, 1992).

With regard to our research question on the overall effectiveness of L2 reading strategy interventions, our result of an average effect size of *.91* supports the educational benefits of L2 reading strategy interventions on reading comprehension performance. Our finding concurs with results from previous meta-analytic studies of L1 studies investigating reading strategies (Berkeley, Scruggs, & Mastropieri, 2009). These are similar to findings of Edmonds et al. (2009), who reported an overall effect size of *.89*, and Swanson (1999), with an average effect size of *.72*. However, as it should be noted that studies with significant effect sizes tend to be published more often than studies that show no effect. Positive effect sizes may possibly be the result of overestimation, meaning that we must exercise caution when drawing a conclusion regarding overall effect sizes. Nevertheless, an effect

size of *.91* is an encouraging indication that L2 reading performance can be served by reading strategy instructional input.

Regarding our research question on the influence of reading strategies on L2 reading performance, our results indicate that reading performance is positively affected by a number of the reading strategies tested. This leads us to conclude that a combination of reading strategies are effective, the most particularly effective being: *connecting new knowledge to what is already known*, *asking questions while reading and activating background knowledge*. Moreover, the reading strategies of *visualization* and *looking at pictures* do not appear to be particularly effective reading strategies for L2 reading performance, according to the studies tested. These findings are in congruence with an L1 study by Berkeley, Scruggs & Mastropieri (2009) who reported the effectiveness of structured cognitive strategy instruction featuring reading strategies such as *using background knowledge* or *connecting new knowledge to what is already known*, which were found to be particularly effective strategies.

Our third question focused on whether the effectiveness of L2 reading strategies is dependent on the type of pedagogical approach. We found that it mattered not only which type of strategies were taught but whether a standard teacher or non-standard teacher of the class taught the intervention. For not only when the standard teacher taught the intervention did this result in overall smaller effect sizes, there was more variation between reading strategy effectiveness when the non-standard teacher taught the intervention. This is particularly true for the reading strategies *connecting new knowledge to what is already known, making predictions while reading*, and *activating background knowledge*. Our findings concur with those found in the synthesis of reading interventions of Edmonds et al. (2009) where the unfamiliar instructor was found to be more effective in interventions than the familiar teacher of the class. Edmonds et al. (2009) attributed the effectiveness of the non-standard teacher to their attentiveness in implementing interventions with high levels of fidelity during implementation and noted that standard teachers may want to "*consider their fidelity of implementation*" during reading interventions (p. 294). The effectiveness of the non-standard teacher might also be due to their familiarity and explicit knowledge of the theory of reading strategies, which may be ascribed to their expert role in the research (Berkeley et al., 2009). Another explanation is that strategy teaching may require more "ownership" of the material and that more implicit understanding of the theories behind strategy research may be needed in order to become more effective in strategy teaching (Allen, 2003). This is a point that we will address in the recommendations for teaching.

We found that the combination of reading strategy and specific pedagogical approach was effective for some reading strategies but not for all. For example,

teacher modelling was effective with the reading strategies of *visualization* and *skimming and scanning* and *connecting new knowledge to what is already known* appears to be effective when combined with the pedagogical approach of student collaborative practice. That collaborative practice, when it was used as a key element of teaching approach, did not significantly outperform control groups corresponds to some extent with the second model, that the teacher modelling the strategies does not have the same effect for all strategies. Our results suggests that while collaborative practice as a moderator may have been featured in the intervention, it did not have sufficient 'power' to demonstrate its effectiveness.

The approach of student self-practice seemed to be effective with the strategy of *activating background knowledge*, and the strategy *semantic mapping* appears to be effective with the approach of the teacher introducing the strategy. However, the pedagogical approaches in the studies were not always reported; furthermore, the approaches within a study may have been combined or not tested at all, that is, it was not always possible to know with certainty their role during the intervention.

There is always the concern that the number of studies with one particular approach is too limited. In our case, the number of studies with a particular pedagogical approach varied between 40 and 45, with some overlap, meaning, we cannot rule out the possibility, that with more studies the effectiveness of this approach might have been different. Our findings concur partly with the study of Pintrich and De Groot (1990), whose research pinpointed the importance of students exerting control over their own reading by incorporating a pro-active approach to strategies into their reading activities, such as using one's background knowledge, asking questions while reading, and *connecting new knowledge to what is already known*, which; what is already known, which were found to be particularly effective reading strategies in this analysis. Furthermore, according to Dignath, Buettner, and Langfeldt (2008) the benefit of being in charge of one's own reading with self-regulatory learning programmes was found to be an effective approach. Nevertheless, we offer a tentative conclusion with regard to our third research question on the role of reading strategy effectiveness and teaching pedagogy approaches. We conclude that there is a degree of uncertainty to the process of extracting pedagogical approaches from intervention design descriptions and that, as researchers and educators, our implicit understanding of how learning and teaching interact with each other has not developed sufficiently (Rijlaarsdam et.al., 2018, p. 284).

We observed that the difference in effect sizes for studies conducted within higher education institutions was higher ($\Delta g = .49$) than those conducted within secondary schools. This may be due to the fact that while secondary school is mandatory for all children, higher education is chosen by those who wish to con-

tinue their education of choice whether for academic or vocational purposes. A longitudinal analysis of Chicago school students and their educational outcomes by Lesnick, George, Smithgall and Gwynne (2010) found correlational evidence that students who read well at lower secondary school level performed better at college than their peers who read poorly at secondary school.

Looking at study design, we feel that we should mention that studies in our analysis using a within group design, were analysed according to the available pretest and posttest measures, standard deviations and sample sizes in order to calculate an effect size. Plonsky and Oswald (2012) have advocated caution and separation when handling data from studies with pretest-posttest designs with separate control groups when other studies in the sample use a within group design, because pretest-posttest with separate control designs tend to produce larger effect sizes. We decided, for this reason, to err on the side of caution when dealing with the different methodological designs within our meta-analysis.

Whereas one aim of a meta-analysis is to determine and isolate the useful and effective aspects of an intervention, meta-analysis can also contribute by pinpointing ineffective aspects. For example, we observed that the duration of an intervention did not influence the effectiveness of reading performance. The minimum duration of an intervention in our sample was six weeks, and the maximum was 104 weeks, providing us with an average intervention duration of 13.6 weeks. Our result corresponds with the findings of Rosenshine et al. (1996); their L1 analysis indicated that longer durations of interventions do not necessarily result in improved reading performance. Moreover, Rosenshine et al. noted that there is no conclusive evidence of a correlation between longer durations of reading interventions and increased reading performance results. This point notwithstanding, Vaughn et al. (2010) investigated tutoring programmes in reading for students at risk and found that effect sizes of such studies decreased as tuition duration in weeks increased, suggesting that shorter duration may result in higher effect sizes. (Elbaum, Vaughn, Hughes, & Moody, 2000). Nevertheless, Vaughn recommended longer interventions in the case of struggling readers in order to effectively close the gap with typically higher achieving readers (Vaughn et al., 2010).

In contrast, Edmonds et al. (2009) observed in a meta-analysis of L2 reading interventions that although longer interventions may seem to play a role in helping students apply strategies more proficiently, a longer duration of a study did not seem to improve the students ability to apply new strategies flexibly, independently, or in new contexts. All in all, the issue of intervention duration is a complex one, and the contrasting advice from experts has lasting implications for future reading strategy research, as researchers and schools will have to consider

and weigh both potential benefits and drawbacks of shorter and longer interventions (Berkeley et al., 2009; Gajria et al., 2007; Rosenshine et al., 1996).

There was a significant difference found between the effect sizes of standard or non-standard tests ($\Delta g = .68$). Standardized tests in our sample produced smaller effect sizes than non-standardized tests. These findings are supported by the findings of Rosenshine et al. (1996) who reported both significant and non-significant results for standard and teacher self-made tests in an L1 meta-analysis of twenty six studies ranging from the third grade to higher education level. Studies that administered a standardised test reported lower effect sizes than those using a non-standard test (Riffert, 2005). While self-made tests may be more tailored to the teaching programme of the intervention, standard tests could be considered more robust and objective for the purpose of empirical research. Other aspects such as study context (EFL or ESL) or teacher versus researcher did not appear to have any influence on the effectiveness of L2 reading performance within the bounds of this meta-analysis.

4.1 Limitations of this study

Our intention in this meta-analysis was to ascertain which L2 reading strategies were most effective in reading comprehension. To this end, we distinguished and compared ten core reading strategies in effectiveness. Our results suggest that interventions should endeavor to offer a wide range of reading strategies and combine these with different pedagogical approaches, as our results indicate that one approach may not necessarily be effective with all reading strategies. This is in order to reach as many students as possible, rather than to concentrate on one or two strategies and one pedagogical approach.

While the interpretation of our results in general remains a tentative one, due to the considerable heterogeneity between studies which cannot be fully explained by identifiable factors, it is conceivable that the number of small studies in our sample (total participants < *50*: $n = 20$) may have accounted for greater heterogeneity between studies. It is also possible that if the studies we selected had contained larger samples of participants, there might have been more heterogeneity within the studies, and less between studies; however, as these were the studies that met our stringent selection criteria, the point is moot. Moreover, our studies differed greatly and diversely in terms of teaching materials, teaching instructions and the reading tasks administered. The details of these were not always clearly documented in the study methodology, which may account for some degree of heterogeneity between the studies, which, unfortunately, we are unable to explain within the parameters of this study.

Lastly, a review of 174 L2 interactions by Plonsky and Gass (2011) found that as average effect sizes continue to fluctuate over time, fluctuation is attributed to the introduction of more sophisticated models of interaction developed over the last 30 years that have increased subtlety in investigation (Plonsky & Gass, 2011). The hypothesis offered by Plonsky and Oswald (2012) that in the future we could expect larger effect sizes, as improvements in design and measurement in particular research areas surpass previous imperfections. Their hypothesis is corroborated by this meta-analysis. We offer the prognosis that future meta-researchers may continue to expect substantial fluctuation in terms of effect sizes, and that the interpretation of meta-analytic results will continue to remain both a challenging and a complex undertaking for the meta-analysist.

4.2 Suggestions for further research

We extend the careful conclusion that a wide range of L2 reading strategies appears to be effective when taught by a non-standard teacher of the class, who employs a variety of pedagogical approaches. We urge more research to be undertaken to explore this supposition, and hope to be able to add to the field of research ourselves by undertaking further L2 reading strategy research, where we will attempt to put our own L2 reading strategy method to the test with L2 reading students, the results of which we believe may have relevance for secondary and higher education. Research into L2 reading strategies should especially be supported, as we believe that this is an area that could benefit from more academic interest, especially as students in higher education are expected to be self-sufficient in their pursuit of the required reading and study skills. While our sample of reading strategies was relatively small, we feel that these positive results are encouraging. We also recommend more funding in L2 reading research featuring a wide range of high order reading strategies such as *connecting new knowledge to what is already known* and *asking questions while reading*, in the context of L2 reading strategy teaching, while taking into account the sociocultural context, the student, teacher and setting. The field could also benefit from more research into improved methods of measuring and maintaining reading comprehension.

Furthermore, we believe adolescent and young adult literacy problems that have been brought to attention in the studies of this meta-analysis warrant additional research into L2 reading remediation among adolescent and young adult and adult students, along with studies investigating engagement, involvement with text, motivation to read, self-efficacy and reading for academic purposes. Lastly, we observed that relatively few studies in our sample used a delayed posttest (8%). In order to arrive at a conclusive claim on reading strategy retention

and the effectiveness of the intervention in the long term, we believe that a delayed posttest should be included as common practice in reading study design.

4.3 Recommendations for teaching practices

On the basis of our findings, we recommend the teaching of the widest possible range of high order L2 reading strategies and the development of teaching materials that enable diverse pedagogical approaches in the classroom. From our analysis, we postulate the following: Successful L2 readers are those who engage in cognitive and metacognitive activities that involve self- planning, monitoring, evaluating and, when necessary, re-evaluating their reading efforts. We observed that the non-standard teacher seems more effective in teaching certain strategies than the standard teacher and that certain pedagogical approaches are more effective with particular reading strategies. We believe that while the non-standard teacher of the class may maintain a higher level of fidelity towards the intervention, on the other hand, the standard teacher's ability to scaffold and support meta-cognitive thinking is more in line with student support (Dignath et al., 2008).

For this reason, action research, where teachers participate in designing and implementing classroom research projects for the purpose of improving their teaching approach, should be encouraged by schools and universities. However, more research would be welcome on this topic. We also encourage more support for teacher development in L2 reading strategies as a matter of good practice. We believe that a better understanding of reading strategies in the L2 reading classroom will help teachers, and those involved in educational planning to approve improve and innovate reading instruction in their institution.

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Appendix. Studies with multiple treatment groups

McKeown, et al., (2007): 3
McNeil (2011): 3
Vaughn et al. (2011, 2009): 3
Fatemipour (2016): 3
Wettlaufe (2016): 3
Amirabadi, et al., (2016): 3
Rakhshan, et al., (2015): 4

Table 1. Description of studies included

Study and Date	Description of intervention	Published (Yes or No)	N	Reading strategies used in study	Standard test (Yes or No)	Standard teacher (Yes or No)	Effect size
Abed (2017)	Using summary strategies	Y	59	10	Y	Y	.58
Akkakason (2013)	Strategies based approach	Y	164	1, 2, 4, 6, 9	Y	Y	.81
Alenzi (2016)	Enhancing reading skills	Y	65	1,4,8	N	Y	1.26
Amirabadi, et al., (2016)	Self-regulation and problem solving in reading comprehension	Y	50	1,2,3,4,8,9,10	N	N	.84
Amirabadi, et al., (2016)	Critical thinking and problem solving through scaffolding reading	Y	50	1,2,3,4,8,9,10	N	N	.36
Amirabadi, et al., (2016)	Scaffolding and self-regulation in reading	Y	50	1,2,3,4,8,9,10	N	N	1.47
Bagheri et al., 2016	Focused tasks	Y	90	1,6,7,8,9	Y	Y	.70
Bimmel, et al., (2001)	Pair assisted consciousness raising reading strategy training	Y	21	3,9,10	Y	Y	.69
Cubukcu (2016)	Enhancing vocabulary development	Y	130	1,2,3,4,8	Y	Y	.13
Dabarera, et al., 2016	Reciprocal teaching approach	Y	67	1,2,3,8,10	Y	Y	.14
Dreyer & Nell (2003)	Learning content management system	Y	131	1,2,3,4,5,6,8,9,10	Y	Y	.89
Fatemipour, et al., 2016	Co-operative group approach	Y	40	2,3,9,10	Y	Y	.48
Fatemipour (2016)	Visualisation group reading	Y	40	2,3,9,10	Y	N	.12
Ghaniabad (2016)	Multimedia texts on interactive whiteboards	Y	53	2,7,9	Y	N	−0.39
Gurk, et al., 2016	Co-operative learning techniques	Y	60	1,2,4,8,9,10	Y	Y	3.65
Hind (2016)	Blended learning prog.	Y	50	1,2,8,9	N	N	5.31

Table 1. *(continued)*

Study and Date	Description of intervention	Published (Yes or No)	N	Reading strategies used in study	Standard test (Yes or No)	Standard teacher (Yes or No)	Effect size
Jafari, et al., 2016	Utility of concept orientated reading	Y	60	1,2,3,8,9,10	Y	Y	2.75
Kadhodaee, et al., (2016)	Self-generated vs. Group generated text based questions	N	63	9	Y	Y	.84
Karimi (2016)	Prior topic knowledge and strategic processing in AP multi text comprehension	Y	48	1,2,4,5,7,8,9,10	Y	Y	.10
Karizak, et al., 2016	Think aloud protocols	Y	100	2,3,6	N	N	1.34
Karbalaei (2011)	The cognitive academic language learning approach	Y	189	3,10	Y	N	1.72
Kusiak (2001)	Metacognitive strategy training on reading comprehension	N	158	2,3,6,10	N	N	.46
Lee (2007)	Reading strategy awareness raising	N	72	3,4,6,9,10	N	N	.61
Lestari (2016)	Using visual scaffolding strategies	Y	70	5,7	Y	N	1.16
Macaro, et al., (2008)	Longitudinal study of L2 French reading	Y	86	1,2,4,6,7	N	N	.16
McElvain (2010)	Transactional literature circles	Y	150	1,2,3,4,5,8,9,10	Y	Y	.40
McKeown, et al., (2007)	Think aloud strategies	Y	27	1,4,7,8	Y	Y	.34
McKeown (2007)	Think aloud and self-questioning strategies	Y	27	1,4,7,8,9	Y	Y	.83
McNeil (2011)	Background knowledge and self- questioning	Y	30	1,8,9	N	N	5.7
McNeil (2011)	Self questioning	Y	30	1,8,9	N	N	4.29

Table 1. *(continued)*

Study and Date	Description of intervention	Published (Yes or No)	N	Reading strategies used in study	Standard test (Yes or No)	Standard teacher (Yes or No)	Effect size
Mozafari, et al., (2016)	Critical orientated reading strategies	Y	109	2,3,9,10	Y	Y	3.29
Nasjaji (2003)	Vocabulary learning from context	Y	21	1,2,4,7	N	N	.04
Ntereke, et al., (2016)	Academic literacy instruction	N	30	1,2,3,8,10	N	Y	.22
Olson, et al., (2012)	Cognitive strategy interpretive reading	Y	54	1,2,3,4,5	Y	Y	.64
Olson & Land (2008)	Pathway Project: Cognitive strategy approach	Y	547	1,2,3,4,5,8,9,10	Y	Y	.54
Pappa, et al., (2003)	Metacognitive strategy training	Y	38	3,10	Y	Y	.80
Proctor, et al., (2009)	Deep vocabulary instruction	Y	240	2,4,5,8,9	Y	Y	.41
Quanwal, et al., (2014)	Intensive reading strategy instruction	Y	40	1,2,3,4,5,6	N	N	.16
Rakhshan, et al., (2015)	Dynamic assessment	Y	175	1,2,4,5,8,9,10	Y	Y	−0.93
Rodriguez, et al., (2016)	EFL text-based questioning	N	40	1,2,3,6,9,10	N	Y	−1.07
Safarpoor, et al., (2015)	Self-questioning as a generative learning strategy	Y	60	8,10	Y	Y	.20
Salataci (2002)	Think aloud protocols	Y	8	1,2,4,5,8,9	Y	N	1.73
Shang (2010)	Self-efficacy and EFL reading comprehension	Y	53	3,4,6,9	Y	Y	.41

Table 1. *(continued)*

Study and Date	Description of intervention	Published (Yes or No)	N	Reading strategies used in study	Standard test (Yes or No)	Standard teacher (Yes or No)	Effect size
Sporer (2009)	Peer assisted reading strategies	Y	186	3,4,9,10	Y	Y	.31
Suk (2016)	Extensive reading	Y	171	2,3,4,10	N	N	.46
Trendak (2014)	Strategy training in FL learning	Y	40	1,2,8,10	N	N	1.52
Urlaub (2012)	Generating questions	Y	21	9	N	N	.88
Vaughn, et al., (2011)	Multi-component reading comprehension on instruction	Y	782	1,2,4,7,8,9,10	Y	Y	.12
Vaughn, et al., (2011)	Silent reading ability	Y	782	1,2,4,7,8,9,10	Y	Y	.13
Vaughn, et al., (2009)	Teacher led student reading	Y	414	4,10	N	Y	.28
Vaughn (2009)	Paired student reading	Y	414	4,10	N	Y	.28
Wetlaufer (2016)	Balanced strategy instruction	N	20	1,2,4,8,9	Y	Y	.01
Wetlaufer (2016)	RI-understanding explicit instruction	N	20	1,2,4,8,9	Y	Y	.47
Wetlaufer (2016)	Making connections from reading to personal knowledge and instruction	N	20	1,2,4,8,9	Y	Y	.40
Yapp (2015)	Intensive stategy training	N	36	1,4,5,8,9	Y	Y	.65

Reading strategies:

1. Activating background knowledge
2. Guessing meanings from context
3. Semantic mapping
4. Making predictions while reading
5. Visualisation
6. Skimming and scanning
7. Looking for clues in pictures and headings
8. Connecting to new knowledge to what is already known
9. Asking questions while reading
10. Paying attention to structure

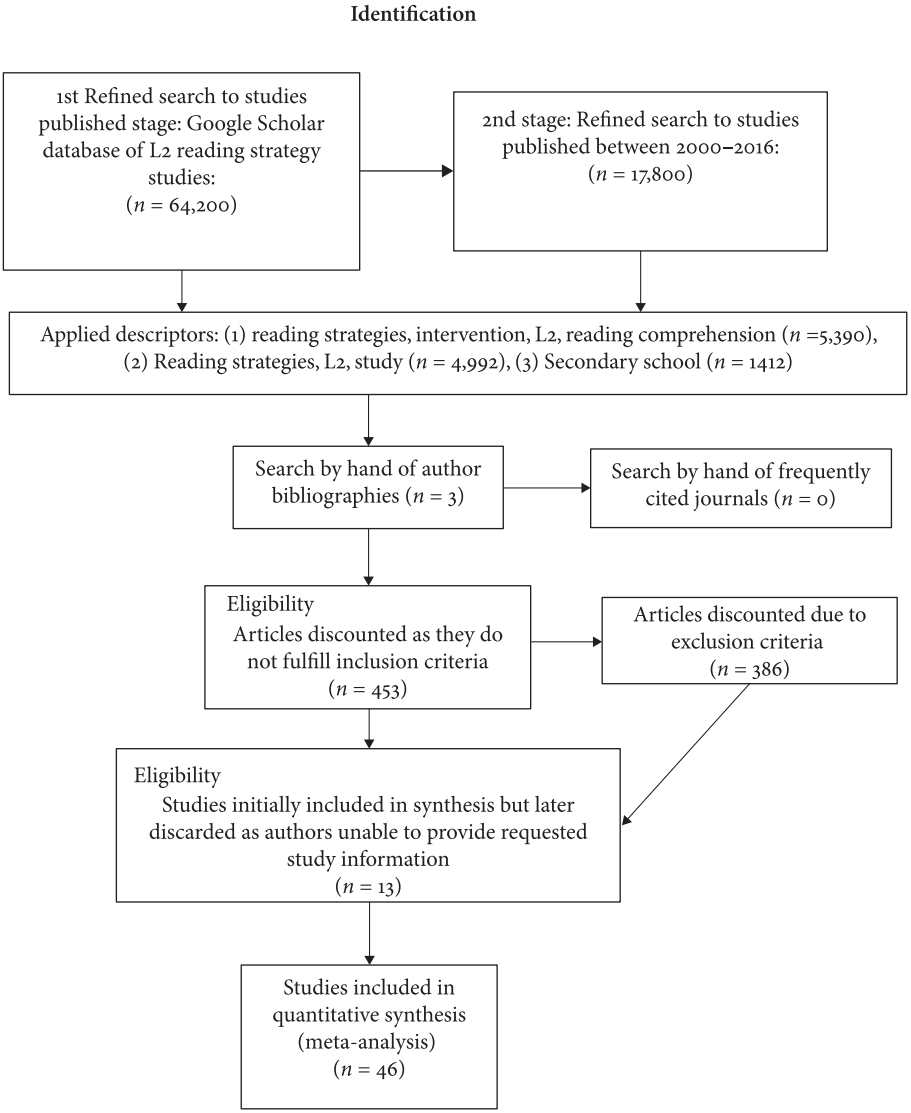

Figure 2. The search procedure

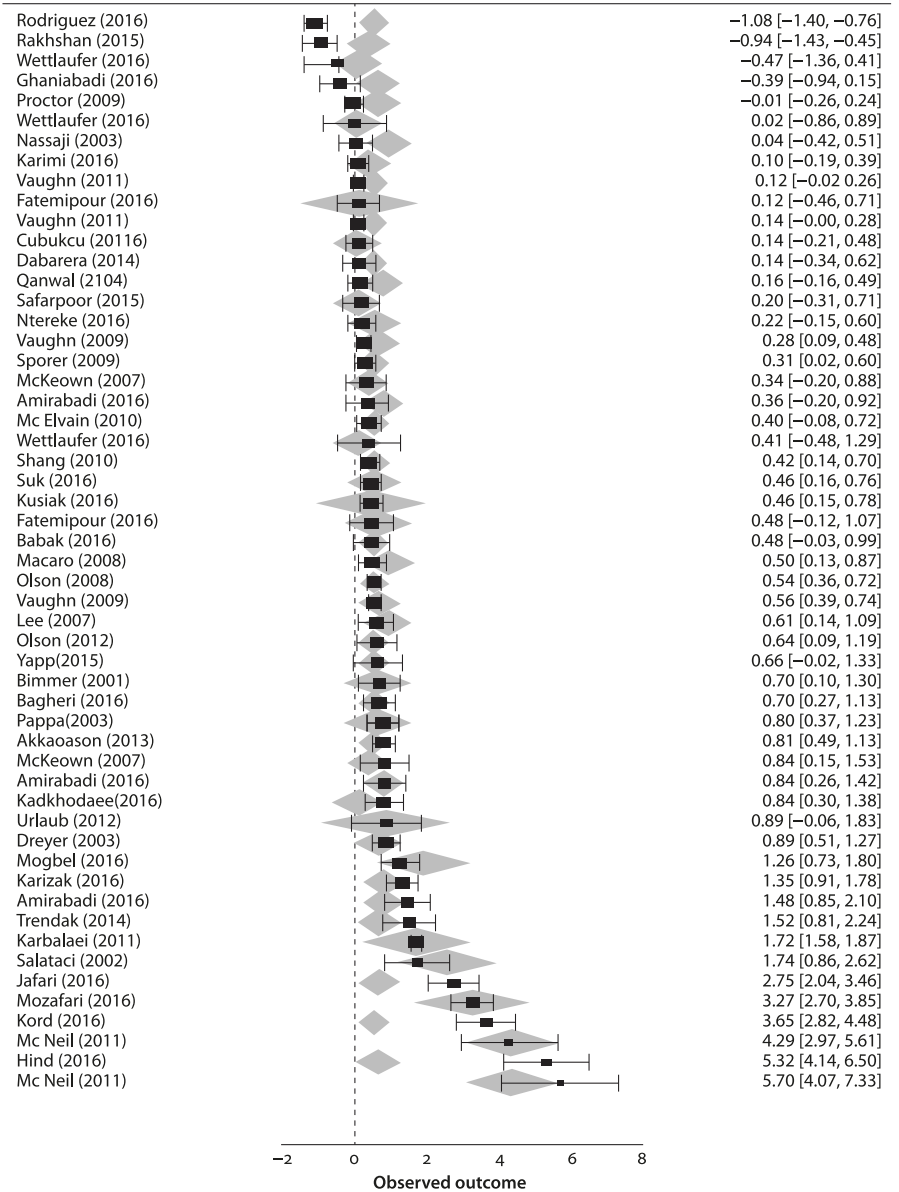

Figure 3. Forest plot showing studies with measure of effect and observed outcomes

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