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Meta-Analysis of the Effects of Traditional versus Technology-based Instruction on Reading Comprehension of EFL Students

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Abstract
Reading is an essential skill for language acquisition, especially for learners of English as a Foreign Language (EFL). Reading comprehension is essential for academic success, thus teachers and researchers are consistently testing new strategies and resources to assist EFL students. Given the growing technological infrastructure many schools are forgoing traditional strategies for digital reading resources. Thus, the purpose of this meta-analysis investigates the effects of using strategy instruction versus technology-based instruction on the reading comprehension of EFL learners. A Meta-analysis of 17 studies (20 effect sizes) published between the years 2007 and 2016 was conducted. A three level inclusion and exclusion process was used to select studies based on the a priori criteria. The overall combined effect size for traditional strategies and technology-based strategies was (d=1.176), which is considered a large effect size. The findings of the moderator analysis suggest that the use of traditional reading strategy instruction or technology-based reading instruction is equally effective for supporting the reading comprehension of EFL students. Recommendations for enhanced teaching and learning are provided to support EFL student reading comprehension.
Key-words*: reading comprehension, EFL, strategy instruction, technology-based instruction*

1. INTRODUCTION

Comprehensive summaries of the effects of instructional strategies and resources on language learning are essential for research and praxis. Language conveys meaning and contributes to the sharing of ideas and information, thus when written language is successfully understood, reading can be a powerful skill and an inspiring tool. Appropriately, reading is an important skill in acquiring a language for learners of English as a foreign language (EFL). Reading helps EFL learners to build their vocabulary and improve their L2 skills (Taguchi, Melhem, & Kawaguchi, 2016). Research in EFL reading has focused on several factors that affect reading comprehension. King (2008) believes that four factors are included in reading comprehension. They are the reader, the text, the strategy, and the goal. Reading strategies are actions of how readers conceive a task, how they make sense of what they read, what they do when they do not understand, and what cues they attend to (Cohen, 2014). For the purpose of this study we focus on the EFL reader, technology and traditional strategies, and the effects of these variables on reading achievement. The use of technology has become essential around the world. The influence of technology can also be seen in modern reading instruction. Technology-based learning may provide an active learning environment for many students. Both traditional and technology-based approaches are used in ways that complement each other and promote student achievement (Cheung & Slavin, 2013). Yet, the influence of technology and traditional instructional strategies on the reading achievement of EFL learners has yet to be systematically reviewed and synthesized.

2. TRADITIONAL VERSUS TECHNOLOGY BASED READING INSTRUCTION

The affordances and constraints of traditional reading instruction and technology-based reading instruction are numerous. Yet, many teachers are drawn to the allure of new technological resources or steeped in their familiarity with traditional reading instructional strategies. In the following discussion we examine the benefits and constraints of traditional reading instruction and technology-based instruction to support the reading comprehension needs of EFL students.

2.1 Traditional Reading Instruction

Academic reading can present a challenge for students in their first language (L1), and can be substantially more difficult in their second language (L2). Reading strategies are an essential part of language learning and reading comprehension for EFL students. Reading strategies assist learners in the development of long-term metacognitive reading systems. A strategy is "a multiplicity of actions, careful integrating available means in order to achieve desired ends" (Marcella, 2010, p.13). Garber (1991) defines reading strategy as "a deliberate action that readers take voluntarily to develop an understanding of what they read" (p. 379). A strategy is neither art nor a science, but rather both. As an art, it is the ability to think strategically, and this is a skill, which can

be developed by studying, observing, and experiencing. As a science, thinking strategically requires the pursuit of knowledge, collection of information, and analysis of different hypotheses to solve a problem (Marcella, 2010). Given the complex nature of reading strategies, it is important to consider the quality rather than the quantity of strategies to improve the reading comprehension of EFL students.

Alsamadani (2009) indicates that the kind of reading strategy that one employs is essential, whereas the quantity of reading strategies practiced while reading does not ensure greater reading comprehension. The quality of strategies can improve reading comprehension and increase awareness of readers' performance as they read. Therefore, researchers must recognize the significant role of metacognitive awareness in reading comprehension. Researchers who investigate reading strategies of L1 and L2 readers have suggested that comprehension activities of proficient readers take place at the metacognitive level (Pressley, 2002; Wen, 2003). There are two type of metacognition: (1) metacognitive knowledge and (2) metacognitive regulation (Thillmann, Gößling, Marschner, Wirth, & Leutner, 2013). Researchers also posit that there is a relationship between metacognitive awareness-raising and reading comprehension improvement. This indicates that metacognitive strategy is efficient and is statistically significant in increasing reading comprehension (Dabarera, Renandya, & Zhang, 2014).

According to Alsamadani (2011) using different comprehension strategies improves the reading comprehension of EFL learners. Associated skills such as writing also support the reading comprehension of EFL learners. For example, Balenghizadeh and Babapour (2001) found that reading comprehension can be significantly enhanced through writing. The authors suggest that written works or summary writing strategies not only develops student reading comprehension, but also enables them to recall the content longer.

2.2 Technology-based Instruction

Technology is a useful educational tool to support the reading comprehension of EFL students. However compared to traditional reading instructional strategies, technology-based reading strategies are still in their infancy. Brantmeier (2003) examined how instructors perceive the integration of technology-based materials in the second language (L2) reading process. The participants were ten Ph.D. students who were enrolled in a seminar on second language acquisition (SLA) and Computer Assisted Language Learning (CALL) for a semester. The findings suggest that the use of technology improved the use of class time in more collaborative ways and that students' reading comprehension was statistically significantly improved. The researcher hypothesized that technology enhanced student motivation, which influence its effectiveness. Motivation is one of the key affordances of technology-based reading instruction. As Lee (2000) states, students feel more independent with computers, and motivation rises. More explicit affordances of technology also abound.

Technology can facilitate reading comprehension when utilized in an informed and responsible manner. Huang (2014) investigated the impact of computer-based reading instruction versus paper-based instruction in the college EFL teaching context. The results of the study show that the online reading group had higher reading comprehension than the paper-based group. According to Mathews one explanation for this finding is that "reading and interaction with a book on a computer screen has the potential to be a powerful motivation force for even the most reluctant readers" (p. 380). Finally, Chen et al. (2013) examined the effects of an e-book extensive reading program on EFL students' English reading attitude. The findings suggest that the experimental group has statistically significantly better reading attitudes and reading comprehension compared to the control group. Given the consistent positive support for technology-based reading instruction for EFL students, many teachers and researchers may begin to forgo traditional instructional methods in favor of the digital tools. However, previous meta-analytic studies have yet to examine the differential effects of technology-based instruction compared to traditional instruction for EFL student reading comprehension.

A meta-analysis conducted by Davis (2010) investigated the uses of multiple comprehension strategy instruction (MCSI) over 30 years. The findings revealed that the use of MCSI promotes literacy achievement among students in grades 4-8, and provide directions for future research in reading comprehension pedagogy. However, the study did not examine the technology-based instruction as a moderator variable. Because both technology-based and traditional strategies instruction have a consistent positive effect on reading comprehension of EFL learners, the objective of this meta-analysis study is to investigate the cumulative and differential effects of on EFL student reading comprehension.

3. RESEARCH METHODOLOGY

3.1 Literature Search

A literature search was conducted the following databased: Academic Search Complete, ERIC, Education Source, and Google scholar. The initial keyword search produced 95 studies. Out of these, 17 studies (with 20 effect sizes) were retained for use in this meta-analysis. Others were rejected as they did not match the criteria as described below:

The following criteria for inclusion were set:

- The studies were published between 2007 and 2017.
- The study was quasi-experiment or a true experiment.
- Included both experimental (traditional strategy or technology-based method) and control groups.
- The study included EFL learners as the population of interest.
- Studies were peer-reviewed articles (Grey literature were excluded).

Seventeen studies satisfied the above-mentioned criteria were included in the meta-analysis. A flowchart of the inclusion and exclusion process is presented in figure 1.

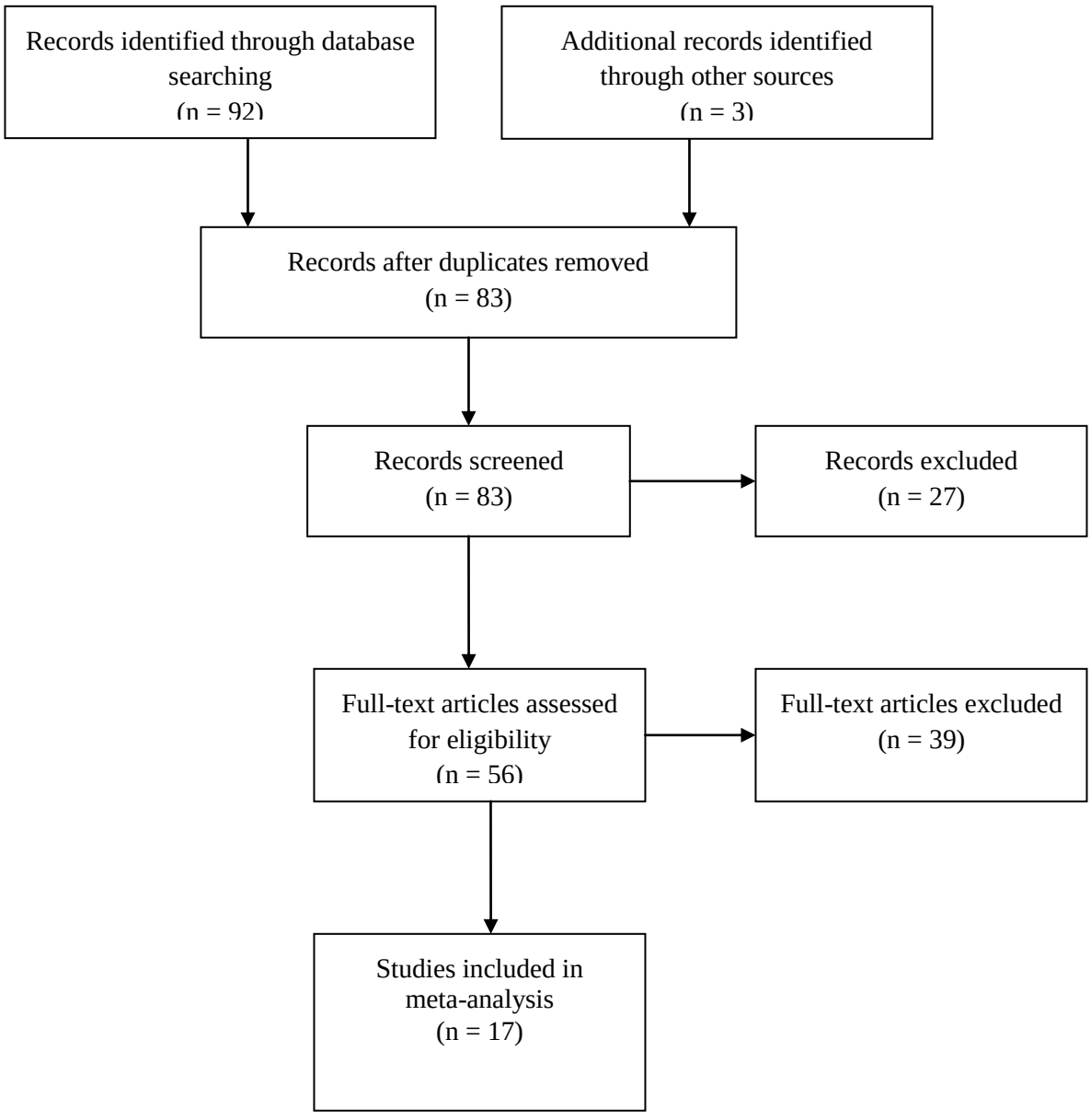

Figure 1. PRISMA flow diagram of inclusion and exclusion of studies.

3.2 Study Characteristics

A descriptive analysis of characteristics of the studies in the meta-analysis was tabulated and presented in the data here. Most of the studies about 29.41% in this meta-analysis were published in the year 2012, while 23.53% were published in 2011 as shown in table 1. The data presented in table 2 suggest that the majority of studies, 47.05% had treatment duration of between 5 to 9 weeks. Most of the included studies were conducted in Iran. The Persian language was the L1 in 35.29% of the studies, and Taiwanese language wad slightly less represented at 23.53% as seen in Table 3. The sample sizes for each study are summarizes in table 4, 41.18% of studies had between 61 and 100 subjects, which was the most representative range of participants. The number of studies that used traditional strategy-based instruction with L2 studies, represented 70.59% percent, while 29.41% used technology-based instruction, complete study details are presented in table 5.

Table 1

Distribution of year of publication across studies

Year	Number	Percentage
2007	1	6.88
2010	2	11.76
2011	4	23.53
2012	5	29.41
2013	1	6.88
2014	3	17.66
2016	1	6.88
Total	17	100

Table 2

Distribution of duration of treatment across studies

Weeks	Number	Percentage
1-4	4	23.52
5-9	8	47.05
10-16	5	29.41
Total	17	100

Table 3

Distribution of first language across studies

L1	Number	Percentage
Arabic	2	11.76
Persian	6	35.29
Taiwanese	4	23.53
Chinese	2	11.76
Indonesian	1	6.88
Singaporean	1	6.88
Malaysian	1	6.88
Total	17	100

Table 4

Distribution of sample size across studies

Sample Size	Number	Percentage
30-50	3	17.66
51-60	4	23.53
61-100	7	41.18
1001-340	3	17.66
Total	17	100

Table 5

Distribution of method of instruction across studies

Method	Number	Percentage
Traditional	12	70.59
Technology	5	29.41
Total	17	100

Table 6 presents the effect sizes and characteristics of the included studies. The data in table 6 where analyzed using Comprehensive Meta-Analysis 3.0. Given the substantial variation in study characteristics we predicted that significant heterogeneity existed and thus planed implement a random effects model to calculate the overall effect size. The random effects model also supports the subsequent moderator analysis necessary to analyze the difference between traditional and technology-based reading strategies. To assess this assumption we observed the *Q* statistic. If the *Q* statistic is statistically significant then the assumption of significant heterogeneity is supported and random effects model is most appropriate.

Table 6

Effect Sizes and Characteristics of studies

Study reference	Language	N	Instruction	Moderator	Age	*ES*
Alsamadani (2011)	Arabic /English	85	3-2-1	Traditional	18-23	1.889
Khatib & Fat'hi (2011)	Persian/ English	60	Phonological Component	Traditional	18-25	1.0631
Safadi & Rababah (2012)	Arabic/ English	107	Scaffolding	Traditional	grade 11	1.6554
Soleimani & Nabizadeh (2012) A	Persian/ English	30	Learner Constructed CM	Traditional	17-18	3.3587
Soleimani & Nabizadeh (2012) B	Persian/ English	30	The map CM	Traditional	17-18	5.198
Soleimani & Nabizadeh (2012) C	Persian/ English	30	Summarize	Traditional	17-18	3.7692
Modirkhamene (2012)	Persian/ English	70	Multiple Intelligences-based	Traditional	16-23	4.281
Baleghizadeh & Babapour (2011)	Persian/ English	50	Summary writing	Traditional	18	2.1161
Dabarera et al. (2014)	Singaporean/ English	67	Meta-cognitive	Traditional	12-15	1.0398

Mistar et al. (2016)	Indonesian/ English	71	Predicting, text mapping and summarizing	Traditional	Grade 10	1.3374
Jalilifa et al. (2007)	Persian/ English	60	Meta-discourse	Traditional	College	1.5921
Choo et al. (2011)	Malaysian/ English	68	Reciprocal	Traditional	sixth form	3.0308
Jiang (2012)	Chinese/ English	340	Graphic organizers	Traditional	19	0.1363
Chen et al. (2013)	Taiwanese/ English	89	E-books	Technology	18-19	1.0309
Sadeghi & Ahmadi (2012) A	Persian/ English	30	Computer-based	Technology	17-20	2.0029
Sadeghi & Ahmadi (2012) B	Persian/ English	30	Computer-based Extended	Technology	17-20	2.9433
Liu et al. (2010)	Taiwanese/ English	192	Computer - assisted Concept mapping	Technology	college	0.7327
Huang, (2014)	Taiwanese/ English	57	Online reading	Technology	college	1.2974
Chen et al. (2010)	Taiwanese/ English	56	Tag-based learning TACO	Technology	high school	0.9512

4. FINDINGS AND DISCUSSION

Effect sizes are related to the magnitude of the effect caused by the treatment. According to Cohen (1992) the effect size is a significant measure in evaluating research. The importance of effect size multiplied with the advent of meta-analysis in late 70's (Glass, 1976), thus in the following discussion the overall and differential intervention effects are presented. In this section the results of the meta-analysis are shown beginning in table 7 below, the overall or mean effect size was 1.176. The confidence interval was 0.818 and 1.534, given that the confidence interval does not

include zero, we concluded that this is a statistically significant mean effect size. As shown in table 7 a statistically significant *Q*, was observed indicating the presence of significant heterogeneity. The large I^2 statistic further substantiates the presence of heterogeneity. Based on the heterogeneity present in the studies the random effects model was implemented. To assess the possibility of publication bias in this meta-analysis we calculated the Fail-Safe *N* and trim and fill. As presented in table 7 the Fail-Safe *N* was large and the trim and fill resulted in zero imputed effect sizes. This indicates that the collected studies are sufficiently represented of the available literature.

Table 7
Overall results of Meta-analysis

					Heterogeneity		Publication Bias	
	k	*N*	*ES*	CI	*Q*	I^2	Fail-Safe *N*	Trim and Fill
Overall Results	20	1561	1.176*	[.818, 1.534]	203.816*	90.678	1399	0

* indicates a statistically significant result.

Table 8 presents the results of the moderator analysis. This study focused on examining the difference between technology-based and traditional instruction to support EFL student reading comprehension, thus strategy was the moderator of interest. From the 12 studies using traditional instruction 14 effect sizes were extracted with a group mean effect size of 0.703. The 95% confidence interval 0.581 and 0.824, and did not include zero. The technology-based instruction category included 5 studies, from which 6 effect sizes were extracted. The mean group effect size for technology-based strategies was 0.707, with a 95% confidence interval of 0.511 to 0.902 that does not include zero. Although both strategies had statistically significant effect sizes, they were approximately the same in magnitude. This along with the non-statistically significant Q_B indicates that traditional and technology-based reading strategies are essentially equally effective mechanisms to support EFL reading comprehension.

Table 8
Teaching strategy moderator analysis

Moderator	*k*	Q_B	*ES*	95% CI
Methods		.001		
Traditional	14		.703*	[.581, .824]
Technology	6		.707*	[.511, .902]

* indicates a statistically significant result.

5. CONCLUSION

This meta-analysis study indicates that there is a positive statistically significant effect of using traditional instruction or technology-based based instruction on reading comprehension of EFL learners. This study supports the educational value of traditional strategy instruction in EFL reading class (*ES* = 0.703). Prior studies also indicate that EFL students who are taught reading through traditional strategies have significantly higher scores of reading comprehension (Ahmadi, 2012; Khatib & Fat'hi, 2011). The results of this study are important because they support traditional strategies, but we would be remiss if we need not remind researchers and teachers that overall effectiveness depends on the strategy quality.

Our study also indicates that technology-based strategies have the ability to improve reading comprehension (*ES* = 0.707). This finding is important because it supports prior research with explicit digital tools. For example, teachers should consider including the ebook into EFL instruction, given it is a powerful reading comprehension tool (Chen et al., 2013). Other studies provide support for general computers and multimedia use to enhance teaching in traditional and online computerized L2 text comprehension (Sadeghi & Ahmadi, 2012). Thus, our study supports prior research that suggests the use of technology-based instruction to improve poor readers' reading ability and narrowed the proficiency gap between good and poor EFL readers (Liu et al., 2010).

To conclude, the most important result of this study was that technology-based and traditional strategies are equally effective resources to support the reading comprehension of EFL students. This is of educative import because oftentimes resources are scarce, and schools must choose whether or not to purchase digital resources to support student learning. Based on the results of our study schools can forgo purchasing digital tools to support EFL reading comprehension if resources are scarce. However, it is important to note that the quality of instruction matters, thus alternatively if schools lack adequately trained teachers; then technology-based resources are an equally effective strategy if the financial resources are available.

In conclusion, as the importance of English proficiency grows, the results of this study have substantial implications for supporting the learning needs of an increasingly linguistically diverse international populous. The overall results of this meta-analysis study contradict the oft-claimed assumption that technology is more effective in teaching than traditional instructional strategies. It revealed that while studies have concluded that differences exist between traditional teaching strategies and technology-based instruction to improved reading comprehension of EFL students, when differences are compared in effect size units there is essentially no difference between using traditional reading instruction or technology-based instruction to support EFL students reading comprehension.

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