

Investigating the effect of radical-based strategies on improving foreign Chinese learners' radical awareness and character meaning production: a meta-analysis

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Abstract: This meta-analysis reviewed 11 articles regarding radical-based instruction strategies and synthesized their results to investigate the effect of radical-based strategies on improving radical awareness and character meaning production among CFL (Chinese as a Foreign Language) learners. The overall results demonstrated that radical-based instruction strategies had a significant effect associated with character meaning production. Furthermore, the differences of the effectiveness were also examined between beginning-level CFL learners and intermediate-level CFL learners.

Key words: Chinese as a Foreign Language; Chinese character learning; radical-based strategies; radical awareness; character meaning production; meta-analysis

1 Introduction

As China is playing a more important role on the international stage, Chinese has become a popular foreign language among non-native learners. In the past few decades, there has been a significant increase in the number of learners of Chinese as a second or foreign language (CSL/CFL) [1][2][3]. The Language Enrollment Survey by the Modern Language Association in 2016, which is the most comprehensive U.S. national survey to date, reported a total number of 53,069 undergraduate and graduate students from 794 two-year, four-year, and graduate-level institutions of higher education have enrolled in Chinese language courses, indicating an overall increase from 51,382 students in 2006 a few decades ago [4]. According to the statistics of NOCFL, there were more than 2.1 million CSL or CFL learners in 2016, and around 6 million CFL learners took Chinese proficiency tests globally [5]. In addition, a total number of 442,773 international students studied in higher educational institutions in mainland China in 2017, representing an increase by 45,138 (11.35%) as compared to 2015 [6].

2 Literature review

2.1 Pinyin and character meaning

Pinyin is the official Romanization of Chinese characters based on their pronunciation. Pinyin plays a significant role in assisting CFL learners to acquire the pronunciation of characters in Chinese. At the initial stage of learning Chinese characters, CFL learners are usually provided with a new character with its Pinyin (pronunciation cue) and the English

equivalent (meaning or translation) by the instructors. The simultaneous presentation of a character with its Pinyin and meaning has become the most popular and accepted strategy in Chinese character teaching and learning [7][8].

2.2 Radical and radical awareness

Chinese divides its system into two parts: the Romanized Pinyin sound system which uses the Latin alphabet to represent sounds, and the logographic writing system, in which certain morphemes represent meanings. The most common forms of these Chinese morphemes are called radicals (bùshǒu) (e.g., 氵, 木, 扌, etc.). They usually function as semantic parts of the entire character [e.g., 氵 stands for water in 湖 (lake), 木 stands for tree in 森林 (forest), etc.].

Radical awareness refers to the sensitivity to identify the role of a radical in a character in Chinese language learning. Shen and Ke made clear the definition as "the functional understanding of the role of radicals in forming Chinese characters and the ability to use this knowledge consciously in learning characters" [9]. Research findings have shown a significant effect of radical awareness and radical-based strategy use on Chinese character recognition among CFL learners [10][11][12]. Research has also shown different understandings of the effect of radical awareness on Chinese character learning among CFL learners with varied Chinese proficiency levels [13][14]. One perspective is that the effect of radical awareness seemed to play a stronger role for CFL learners with higher proficiency levels than those with lower proficiency levels. However, other research has shown the limited effect of radical-based grouping strategies on radical knowledge development and Chinese character learning among higher proficiency-level CFL learners, indicating the saturation of the use of radical knowledge.

In sum, radical-based strategies in Chinese character learning have been studied by many researchers. And evidence has been provided on the effectiveness of radical-based strategies on promoting radical awareness and character meaning recall. Mixed findings have been reported on such effectiveness for CFL learners with different Chinese proficiency levels. Currently, there is no existing comprehensive review to examine the effect of radical-based strategies on improving radical awareness and character meaning production. Therefore, the purpose of the current meta-analysis is to investigate the effect of radical-based strategies on improving both radical awareness and character meaning production, and whether the effectiveness varies by CFL learners' Chinese proficiency level. Four specific research questions are stated and reported in the section of Results.

3 Method

A systematic search for primary studies was conducted in online databases including LLBA, ERIC, PsycInfo, JSTOR, and ProQuest Dissertations & Theses Global. The key words used were "radical awareness" and "Chinese" or "Mandarin" with no limitation on publication year. Seventy-seven records were identified according to their titles and abstracts through database searching. Related articles were also searched in the three major journals including *The Modern Language Journal*, *Language Teaching Research*, and *Foreign Language Annals* from 2010 to 2021. Eleven records were identified according to their titles and abstracts through journal searching.

Of all the 88 records identified, 77 full-text records were available for filtering after 11 duplicates removed. The inclusion criteria for screening were as follows:

- 1) The participants were non-native Chinese speakers. Drawing upon this criterion, 13 studies were excluded.
- 2) The studies were quantitative or mixed-method design so that corresponding statistics could be used to compute the magnitude of the effects in a later step. One qualitative study was excluded.
- 3) The studies were true-experimental or quasi-experimental design with treatment groups and control groups. Fifty-seven studies were excluded.

4) Sufficient statistics were reported, for example, the sample size of both treatment group and control group, the means and standard deviations of the dependent variables for both groups, or other statistics such as t statistic and F statistic. One study was excluded for not reporting standard deviations or other statistics that could be used to compute effect size.

In total, seventy-two studies were excluded in the screening step and 5 studies were first included in this meta-analysis. The reference lists and the "cited by" function provided by Google Scholar were also used for study screening. Six studies were added through this step. In sum, 11 studies were finally included in the current meta-analysis.

4 Results

4.1 Research question 1: Are radical-based strategies effective on improving CFL learners' radical awareness?

Seven studies provided results of radical awareness measures. Heterogeneity between studies was assumed and random-effects model was adopted. The overall weighted effect size was 0.20 ($Z=1.02$, $p=0.31$) for the 7 studies with a total sample size of 392, which was neither a significant nor a large effect size. The forest plot (Fig. 1) also showed that the weighted overall effect size was 0.20 with a non-significant 95% confidence interval from -0.18 to 0.58. Two individual effect sizes fell on the left side of the forest plot. Four individual effect sizes were not significantly different from 0. The results revealed a non-significant effect of radical-based instruction on improving radical awareness.

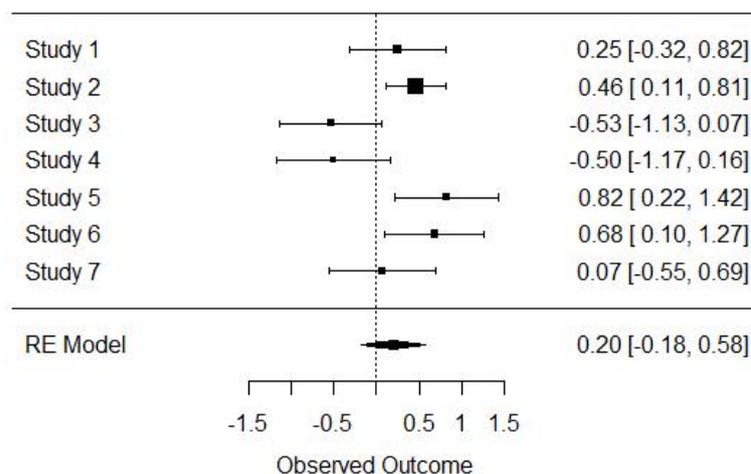


Fig. 1. Forest plot for radical awareness

Q statistic was used to assess effect-size homogeneity. The null hypothesis was that all the individual effect sizes were homogeneous ($\tau^2=0$). The results of the heterogeneity test showed that the individual effect sizes were significantly heterogeneous as under random-effects model [$Q(df=6)=18.70$, $p<0.01$]. I^2 was 70.18%, indicating that there were high variations in effect sizes, about 70.18% of the effect size variability was not explained by sampling error. The test of heterogeneity also provided the rationale to adopt random-effects model.

4.2 Research question 2: Does the effectiveness of radical-based strategies on improving radical awareness vary by CFL learners' Chinese proficiency level?

The mixed-effect ANOVA-like model was used to test whether radical-based instruction effectiveness on improving radical awareness varied by Chinese language proficiency level. The mean difference of effect sizes between beginning-level and intermediate-level was 0.46 ($SE=0.38$, $Z=1.22$, $p=0.22$), implying that radical-based instruction was more effective at intermediate level, but this moderator of Chinese language proficiency level was not found to be significant. $Q_{between}$ statistic also indicated that the moderator of Chinese language proficiency level did not explain enough population

variation [$Q_{between}(df=1)=1.49, p=0.22$]. The mean effect size of beginning-level was -0.01 ($SE=0.25, Z=-0.04, p=0.97$). The mean effect size of intermediate-level was 0.45 ($SE=0.28, Z=1.62, p=0.11$). However, the mean effect sizes of both levels were non-significant.

4.3 Research question 3: Are radical-based strategies effective on improving CFL learners' character meaning production?

Ten studies provided results of character meaning production measures. Of the 10 studies, participants were coded into two studies based on their different Chinese language levels (beginner vs intermediate) and the other two studies were coded due to different multimedia strategies (visual cue vs audio cue) [15]. In total, the effect sizes of 12 studies were analyzed to answer the research questions regarding the dependent variable as character meaning production.

Under random-effects model, the overall weighted effect size was 1.12 ($Z=2.81, p<0.01$) for the 12 studies with a total sample size of 636, which was a significant large effect size. The forest plot (Fig. 2) also showed that the weighted overall effect size was 1.12 with a significant 95% confidence interval from 0.34 to 1.90 . Most of the individual effect sizes fell on the right side of the forest plot and were significantly different from 0. The results revealed that radical-based instruction had a significant positive effect on improving character meaning production.

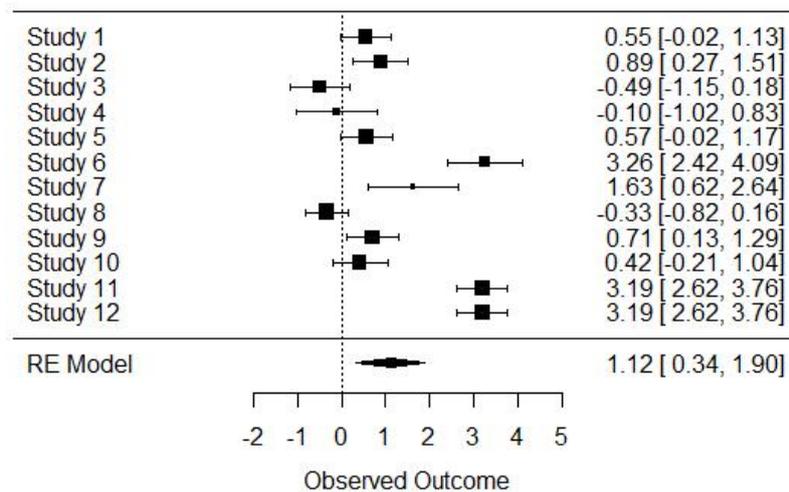


Fig. 2. Forest plot for character meaning production

The results of the heterogeneity test showed that the individual effect sizes were significantly heterogeneous as under random-effects model [$Q(df=11)=204.83, p<0.001$]. I^2 was 94.47%, indicating that there were high variations in effect sizes, about 94.47% of the effect size variability was not explained by sampling error. The test of heterogeneity also provided the rationale to adopt random-effects model.

4.4 Research question 4: Does the effectiveness of radical-based strategies on improving character meaning production vary by CFL learners' Chinese proficiency level?

The mixed-effect ANOVA-like model was used to test whether radical-based instruction effectiveness in character meaning production varied by Chinese language proficiency level (beginning vs intermediate). The mean difference of effect sizes between beginning-level and intermediate-level was 1.18 ($SE=0.75, Z=1.56, p=0.12$), implying that radical-based instruction was more effective at intermediate level, but this moderator of Chinese language proficiency level was not found to be significant. $Q_{between}$ statistic also indicated that the moderator of Chinese language proficiency level did not explain enough population variation [$Q_{between}(df=1)=2.45, p=0.12$]. The beginning-level had a non-significant mean effect

size of 0.53 (SE=0.53, Z=0.98, $p=0.33$). The intermediate-level had a significant mean effect size of 1.70 (SE=0.53, Z=3.22, $p<0.01$).

5 Conclusion

The overall results demonstrated that radical-based instruction strategies had a large effect size associated with character meaning production, but no significant effect size was found associated with radical awareness. For CFL learners who have limited background for logographic writing system, it becomes more difficult for them to detect the different functional parts of a character. Even though they have learned to use the positional and semantic cues of radicals when learning a new character, the final achievement is presented as character meaning memorization and production, namely, radical awareness may not display as a direct result in CFL learners' radical strategy use. In addition, due to the lack of standardized Chinese character radical awareness test, all of the studies adopted self-developed tests with no reliability and validity guaranteed, which might be another reason for the non-significant result in the effect of radical-based strategies on improving CFL learners' radical awareness.

Both moderator effect tests of CFL learners' Chinese proficiency level failed to identify significant differences between beginning level and intermediate level. It was unable to answer whether the effect of radical-based instruction on improving both radical awareness and character meaning production was stronger for intermediate CFL learners or for beginning CFL learners, making it still obscure to understand the pattern of radical-based strategy use for CFL learners with varied proficiency levels. In addition, the proficiency level of CFL learners coded in the current meta-analysis was based on the information provided in the studies. Different criteria for determining CFL learners' proficiency level by different authors might influence the moderator grouping in this synthesis analysis.

Conflicts of interest

The author declares no conflicts of interest regarding the publication of this paper.

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