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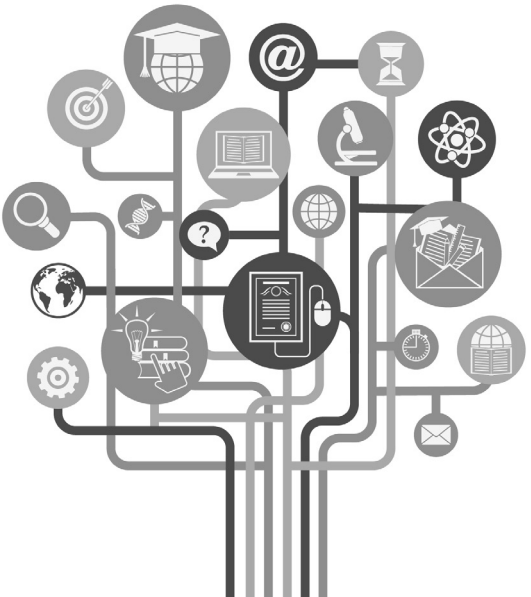

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Lel You[1] and Pelhua Tsal[2]

[1]International College Education Management, krirk University, Bangkok 10200, Thailand
e-mail: vipyoulei80@163.com
[2]International College Teacher, krirk University, Bangkok 10200, Thailand
e-mail: stsai672@gmail.com

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Abstract

Based on the theory of the "Onion Model" of competence, this study uses meta-analysis to integrate the core layer of the Chinese college teachers' competence model. A total of 29 studies were included, with a total sample size of 18,538. Moderator effect, Homogeneity test, Publication bias test, and analysis of the main effect of gender differences in the core layer of the model were conducted to assure more validity and benefit. The results showed that male teachers were superior to female teachers in the core layer of the competence model of college teachers, and the average effect was significant. It also shows that both teachers' position and geographical division of China are effective moderator variables, indicating that male and female teachers have different performances in different positions and regions.

Keywords : Competence; College Teacher; Onion Model; Meta-analysis

Aims and background

McClelland, an American scholar, first proposed the concept of competence in 1973 and divided it into two parts according to the implicit and explicit attributes of competence characteristics, also known as the "Iceberg Model" of competence (McClelland, 1973). Subsequently,

Boyatzis believed that competence is a potential characteristic possessed by an individual that leads to outstanding performance in a certain post. He divided competence characteristics into three categories according to whether they are easy to learn or how easy they are to change, which is called the "Onion Model" of competence (Boyatzis, 1982). By contrast, the Onion model subdivides the characteristics of recessive competence again, which makes the model more hierarchical. Its core layer is composed of traits and motives that are most difficult to measure and change (See Figure 1).

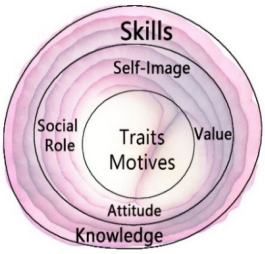

Figure 1 Boyatzis's competence onion model

Research on competence in China began in the late 1990s (Wu Yunna, 1999). After entering the 21st century, China is in a period of rapid economic development, and a large number of suitable talents are needed to assist in all fields. The "Outline of the National Medium and Long Term Program for Education Reform and Development (2010-2020)" clearly emphasized that higher education in the process of building an innovative country's overall status and role is very important, and to improve the quality of scientific research and social support services, it is necessary to pay attention to the faculty building and the construction of faculty ability quality work (Ministry of Education, PRC,2010). As the imparter of students' professional knowledge, the instructor of skills, the influencer of values, and the developer of potential, the importance of

college teachers is self-evident. Therefore, many scholars focus on the research of college teachers' ability and quality. The competence theory caters to the ideas of scholars who want to study, judge, and screen the competence of college teachers, and the number of research is also increasing year by year. However, within the core layer of the competence model, the research conclusions vary greatly. For example, Li Jianzhong pointed out in his study that male teachers scored significantly higher on motive factors than female teachers, and they scored significantly higher on trait factors (Li Jianzhong, 2011). Li Xiaomin believes that there are significant differences between teachers of different genders in the dimension of motive characteristics, while there are no significant differences in other dimensions (Li Xiaomin, 2011). Peng Mingrong's research shows that male teachers are superior to female teachers in many aspects of competence and significantly higher than those in trait and motive factors (Peng Mingrong, 2016). Therefore, this paper intends to use the meta-analysis method to conduct an integrated analysis of the existing literature, focusing on exploring the gender differences of the research samples in the core layer of the competence model of college teachers, and the moderating effects of the position and geographical division of teachers in this analysis.

The research questions of this study are as follows:

(1) In terms of the core layer of the Chinese college teachers' competence model, who has better performance, male teachers or female teachers?

(2) In the analysis of gender differences at the core level of the Chinese college teachers' competence model, are the position of teachers and geographical division the moderator variables affecting them?

Literature review

In competence studies, scholars have different names for competence dimensions. For example, the names of trait dimensions include individual traits(Chen Hoongyan, 2010), personal characteristics(Xiong Sipeng, 2016); motivation dimensions can be called initiative(Qiao Xu, 2019), intrinsic motivation (Yu Yaping, 2020), and other similar naming methods.

According to Boyatzis's definition, trait and motivation are both psychological characteristics related to individual behavior and continuously affect individual behavior, and hidden characteristics that are not easy to directly discover and change. In the Onion model, they all belong to the core part of the competence model, so this paper refers to the trait and motivation dimensions as the core layer of the competence model, which will be integrated for analysis and discussion in the subsequent research. Dimension names such as individual trait (Chen Hongyan, 2010), personality trait (Meng Wen, 2016), traits of character (Luo Xing, 2019; Meng Fan, 2021), personal characteristics (Xiong Sipeng, 2016), motivation (Chen Yan, 2018), achievement motivation (Li Jianzhong, 2011; Peng Mingrong, 2016)and intrinsic motivation (Yu Yaping, 2020) are the same as the previous definition and can be directly classified as core layer. A small number of dimension names, such as self-control (Chen Yansong, 2011), confidence, creativity, attention to detail (Chen Min, 2014), conscientiousness orientation (Liu Sisi, 2019), education concept, and school running concept in education thought (Du Dandan, 2020), can be classified as core layer according to the definition and competence characteristics, although there are no directly related words in the name.

Resarch

Meta-analysis is a method that integrates research results based on existing literature and uses quantitative data to find answers. The process of this study was as follows: literature collection and screening, implementation of quality assessment, data coding statistics, heterogeneity determination, selection of computational effect model, generation of average effect size and analysis, and discussion.

Literature search

The literature collected in this study spans from July 2006 to June 2021. Also, use the literature backtracking method, check the reference section of important materials, and further find the relevant content. As the literature is mainly collected from Chinese master and doctoral databases and journal data, it is easy to cause the problem of "publication bias". Therefore, all literature and materials related to the research topic, whether public or published, will be collected as data samples.

Literature quality assessment

Slavin proposed the integration and standard of the best empirical research and developed a new evaluation mechanism for the quality of empirical research to obtain the optimal strategies and programs (Slavin R.E. et al., 2008). To meet the research needs, literature selection was conducted according to the following four criteria:

(1) In line with the research purpose: It must be a teacher competence study at the stage of higher education. (2) It must be an empirical study. (3) In the empirical research literature, the required data are clearly and accurately expressed, which can provide sufficient quantitative information for effect size calculation and moderating variable analysis. (4) Avoid repeatability. Remove completely duplicate documents and maintain the uniqueness of the data.

Data coding statistics

Coding goes through three main processes. Firstly, the included literature was sorted according to year, and the dimensions, quantity, and research results of each model were counted. Secondly, the corresponding dimensions of college teachers' competence model in the literature were classified and sorted out. Finally, according to the research needs, the quantitative data information of each content was counted to answer the aforementioned research questions.

Effect quantity calculation and integration

Comprehensive Meta-analysis (CMA) software was used to calculate the effect size of the standardized mean difference, and the unbiased effect size calculation method proposed by Hedges was adopted. Publication bias, affect value, 95% confidence interval, heterogeneity test, and other contents were calculated (Hedges&Larry V., 1981). In this study, the method of "changing the analysis unit" was used to make data statistics of each statistical test as an "independent event" at the beginning, and each contains only provided a single "individual effect quantity", and analyzed with the individual effect quantity as the unit, and finally carried out the overall effect evaluation. In literature screening, literature with different background data of research objects and comparative analysis were all selected, so the effective quantity of a single study may be multiple. Zhang Shaoxun gives including criteria that in the process of meta-analysis if type Ⅰ error α=0.05 and type Ⅱ error β = 0.8 were used to calculate, the optimal number of articles included in the meta-analysis would be more than 24 (Zhang Shaoxun, 2014), and 29 articles were eventually included in this study.

Moderator variable

Through literature discussion, it can be seen that the college teachers' position directly related to the competence research of Chinese college teachers and the cultivation of students are mainly divided into three categories: full-time teachers, counselors, and administrators. In geographical division, China is divided into seven regions: North China, Northeast China, East China, Central China, South China, Southwest China, and Northwest China, based on historical and ethnic factors and by relevant geographical division principles. If the included literature is sampled nationwide, the relevant data will not be included in the discussion.

Results

A total of 29 articles related to the competence research of teachers in Chinese colleges were included in the study, and the quantitative data that met the requirements were selected according to the needs. A total of 59 data items were selected from the included literature to analyze gender differences in the core layer of the Chinese college teachers' competence model.

Homogeneity test

The Cochrane Q test and I^2 were used as the criteria for the homogeneity test. When the Q value reaches a significant level, it indicates that there is heterogeneity in the literature, with the characteristic that it is easy to achieve significance when the sample number increases. Then I^2 value is referred to. Higgins, Thompson, Deeks, and Altman have pointed out that I^2 values of 25%, 50%, and 75% represent low, medium, and high levels of heterogeneity respectively (Hedges et al., 2003). Hedges and Vevea pointed out that the fixed effect model should be adopted if the effect quantity is homogenous. If heterogeneity is shown in the effect scale, a random effect model is used (Hedges&Vevea, 1998).

Table 1 shows the results of the homogeneity test. Analysis of gender differences in the core layer of the model, the Q (p <.001) value to a statistically significant level, I^2 was 92.32%, indicating that 92.32% of the observed variation was caused by the difference in the effect size, and 7.68% was caused by random error, indicating the high heterogeneity of it, and the differences in the study were undue to the sampling error of the same parent population. Therefore, the random utility model was adopted in this study. The Tau^2 of gender differences analysis at the core layer of the model was 0.108, indicating that 10.8% of the variation between studies could be used to calculate weighted random-effects model studies.

Table 1 : Homogeneity test results for Meta-analysis of The Core Level of the Chinese College Teachers' Competence Model

Analysis of the name	k	Homogeneity				Tau-squared			
		Q	df (Q)	P	I^2	Tau^2	SE	Variance	Tau
Model core layer	59	755.283	58	<.001**	92.32	.108	.037	.001	.328

*p <.05

Publication bias test

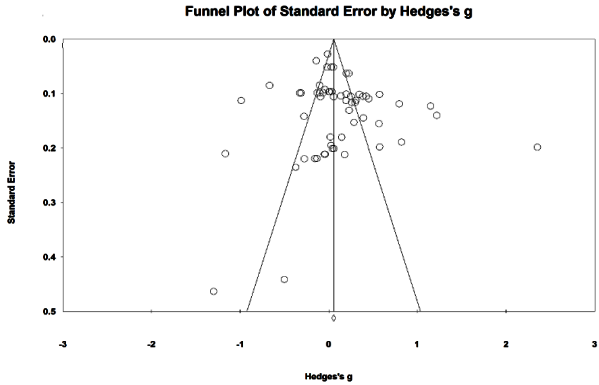

Figure 2 The funnel plot of the publishing error test for the Meta-analysis of the core level

Publication bias tests were performed and analyzed with $N_{f.s.}$ (Classic fail-safe N) values. The test results showed that the $N_{f.s.}$ value was 653, higher than the tolerance number 305 proposed by Rosenthal (5k+10, k was the number of studies) (Rosenthal, 1991), indicating that the weighted average effect size g =0.121 was less affected by publication bias. A funnel plot was used to further check the distribution of effect quantity, and the results are shown in Figure 2. Most effect quantities were distributed on both sides of the top of the funnel plot, presenting a symmetrical phenomenon on the whole, with a few offsets on the periphery of both sides. There were two effect quantities on the bottom side of the funnel, which were less likely to be affected by publication bias.

Analysis of the main effect of gender differences in the core layer of the model

The meta-analysis results of gender differences in the core layer are shown in Figure 3. There were 8,595 male teachers and 9,943 female teachers in the study sample, totaling 18,538 teachers. Among the 59 studies, 28 had a significant individual effect and 31 had no significant individual effect. The overall weighted average effect g value was 0.121 ($p < .05$), 95% confidence interval [.029~.212], excluding zero. The results show that male teachers perform better than female teachers in the core layer of the model. According to Cohen's explanation of the effect size (if it is less than 0.2, it means low effect size; about 0.5 is the medium effect level; above 0.8 is considered the high effect size) (Cohen, 1988), and the weighted average effect size obtained as a result belongs to the low and weak. It shows that the overall performance of male teachers in the core layer was better than that of female teachers in the research on the Chinese college teachers' competence model, and the superior level is low and weak.

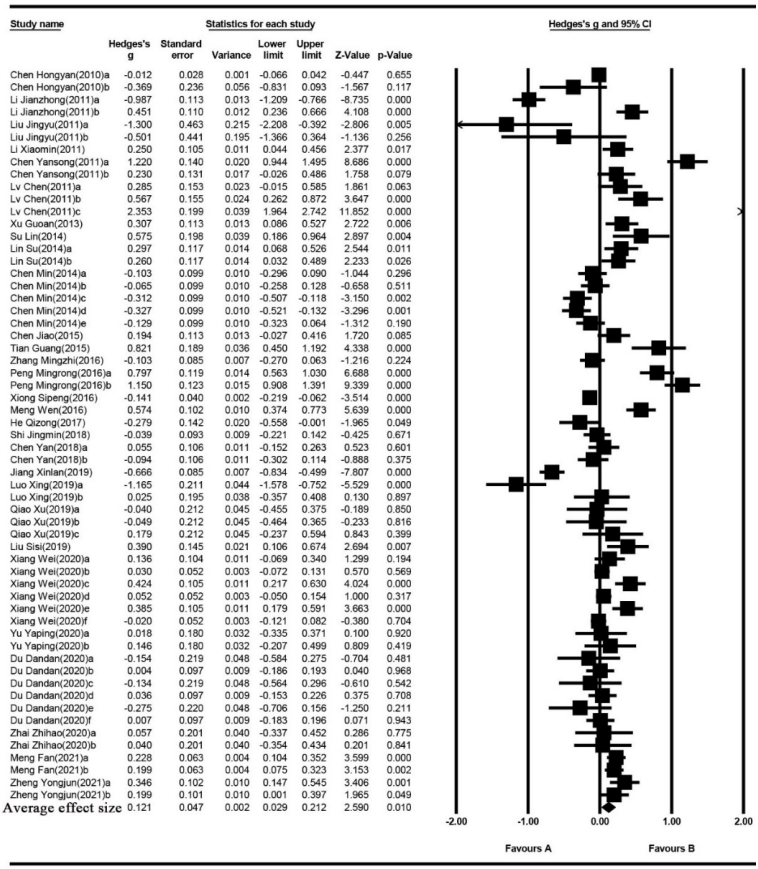

Figure 3 Summary of meta-analysis in the core level of the Chinese college teachers' competence model

Add moderator variables

Based on the literature discussion and the current situation, this paper summarizes the positions and geographical division of teachers in colleges as the moderator variables of gender differences analysis in the core layer. The random effect model was used in the analysis of the overall effect quantity, so the random effect model was also used in the analysis of the moderating effect. The analysis is as follows:

(1) Teachers' position

Table 2 : Moderates variable effect of teachers' position

Homogeneity test			Moderator variable	Classification	*k*	Effect size and 95% confidence interval			Double tail inspection	
Q_B	*df*	*P* values				Point estimation	Lower limit	High limit	*Z values*	*P values*
3.009	2	<.01	Teachers' position	Counselor	21	.301	.158	.444	4.12	<.05*
				Administrators	7	-.311	-.7	.078	-1.568	>.05
				Full-time teachers	31	.065	-.062	.192	.997	>.05

*p <.05

As can be seen from Table 2, the variation among teacher post groups is significant (Q_B =3.009, p <.01), indicating that male and female teachers in the core layer of the model have different performances in teachers' positions, which also indicates that the teacher's position is the moderator variable that affects the analysis of gender differences of teachers in the core layer of the Chinese teachers' competence model. The results showed that at the core level of the model, the overall performance of male counselors was significantly better than that of female counselors, and the superior level was low (r =.301, p <.05). The overall performance of female teachers engaged as administrators is not significantly better than that of male teachers, and the superior level is low (r =-.311, p >.05). The overall performance of male teachers engaged as full-time teachers is not significantly better than that of female teachers, and the superior level is low and weak (r =.065, p <.05).

(2) Geographical division of China

Based on the collected data, the geographical division of China was used as a moderator variable. There was a lack of data from northeast China and South China in the literature collection, so it would not be discussed in this grouping analysis. Some data were sampled nationwide

without detailed geographical division, so it would not be discussed in this grouping. The results were shown in Table 3: Geographical division among groups was significant (Q_B =12.968, p <.05), indicating that male and female teachers in the core layer of the model have different performances in different geographical divisions, which also indicates that geographical division is the moderator variable affecting the analysis of teacher gender differences in the competence of college teachers. The results showed that the overall performance of female teachers in North China was not significantly better than that of male teachers, and the superior level was low (r =-.322, p >.05). The overall performance of male teachers in East China was significantly better than that of female teachers, and the superior level was low than that of female teachers (r =.29, p <.05). The overall performance of male teachers in central China was not significantly better than that of female teachers, and the superior level was low (r =.141, p >.05). The overall performance of male teachers in northwest China was significantly better than that of female teachers, and the superior level was low (r =.249, p <.05); The overall performance of male teachers in southwest China was not significantly better than that of female teachers, and the superior level was low and lower (r =0.089, p >.05).

Table 3 : Moderates variable effect of geographical division of China

Homogeneity test			Moderat-or variable	classification	*k*	Effect size and 95% confidence interval			Double tail inspection	
Q_B	*df*	*P values*				Point estimation	Lower limit	High limit	*Z values*	*P values*
12.968	4	<.05	Geographical division of China	North China	7	-.322	-.658	.015	-1.873	>.05
				East China	18	.290	.042	.537	2.295	<.05*
				Central China	9	.141	-.183	.466	.854	>.05
				Northwest	3	.249	.119	.38	3.742	<.05*
				Southwest	3	.089	-1.015	1.194	.158	>.05

*p <.05

Discussions and Conclusions

A total of 59 items of data from 29 kinds of literature were collected for analysis. The weighted average effect of the meta-analysis was 0.121, indicating that male teachers performed significantly better than female teachers in the core layer of the Chinese college teachers' competence model, and the superior level was low and lower. The results are close to those obtained by Yu Yaping (2020) and Du Dandan (2020). In other related studies, Xu Guoan (2013) and Tian Guang (2015) believed that male teachers' performance was medium or high level, while Chen Hongyan (2010), Li Jianzhong (2011), and Jiang Xinlan (2019) believed that female teachers' performance was better than male teachers, which was inconsistent with the conclusion of this study. In the process of further reference, it was found that although the questionnaire data collected by Zhang Mingzhi (2016), Shi Jingmin (2018), Jiang Xinlan (2019), Zhai Zhihao (2020), and other literature were from the whole country, the sample size of the study was too small, which did not meet Sudman's suggestion on sample size (the research object was nationwide, The sampling number of 1500~2000 people is appropriate)(Sudman, 1976), which may influence the subsequent analysis of moderator variables.

After adding the teachers' position as a moderator variable, the results are as follows:

(1)The position of teachers is a moderator variable that affects the gender differences analysis of the core layer of the Chinese college teachers' competence model.

(2) The overall performance of male teachers engaged in counseling is significantly better than that of female teachers, and the superior level is lower than the upper level. The conclusion is consistent with the results obtained by Zheng Yongjun & Chen Haobin (2021). He believes

that male counselors have some physical, energy, and psychological advantages, and are easier to adapt to the one-to-many communication environment, which can provide help for smooth communication with students.

(3) Engaged in the administrator of women teachers' overall performance is not significantly better than that of male teachers, better than the level belongs to the average level, and Liu Jingyu(2011) the proceeds of the results are identical, women on the personal traits of rigorous, tenacity, confidence, tolerance, such as personality characteristics, to make them better in management positions.

(4) The overall performance of male teachers engaged as full-time teachers is not significantly better than that of female teachers, and their superior level is low and inferior. The results show that male teachers are slightly better than female teachers, which is similar to the conclusions of Chen Jianwen& Wang Zhuhua (2009), Chen Hongyan (2010), and Xiong Sipeng (2016). Chen Min (2014) believed that there was no significant difference between men and women at this level, while Li Jianzhong (2011) believed that female teachers performed better than male teachers, which was inconsistent with the conclusion of this study.

After adding geographical division into the study as a moderator variable, the results are as follows:

(1) Geographical division is a moderator variable that affects gender differences analysis of the core layer of college teachers' competence model.

(2) The overall performance of male teachers in east China and northwest China is significantly better than that of female teachers.

(3) The overall performance of female teachers in North China is not significantly better than that of male teachers. The overall performance of male teachers in central China and South China is not significantly better than that of female teachers.

This study used meta-analysis to conduct an integrative analysis of the current research on the competency of Chinese college teachers. Through the analysis, it can be seen that the overall performance of male teachers was better than that of female teachers, but the degree of superiority was low and weak, which cannot be completely used as a direct basis for teacher selection and training. After adding the moderating variables, it can be seen that the performance of male and female counselors was significantly different, which can be used as one of the supporting materials for the selection of counselors. From the perspective of different regions, there were still many directions that can be further explored in the research of college teachers' competence, such as Northeast China and South China.

Advice

(1) Strengthen the core layer research of college teachers' competence model

In the research process, it is found that at present, the research content on college teachers' competence is more focused on knowledge and skills, while the research data on the core layer is relatively few, and there are not many kinds of literature that can provide sufficient data in the selection process. More attention should be paid to the core layer of the competence model to provide more data support for the development of competence theory.

(2) Colleges pay attention to the selection of personnel core performance.

The teachers' position is the moderator variable of the core level of college teachers' competence. This result means that there are differences or gaps between male and female teachers at the core level. We should further analyze the reasons for this phenomenon and give

more reasonable development suggestions according to the characteristics of male and female teachers.

(3) Administrator positions for more in-depth research

According to the results, the overall performance of female teachers in administrator positions is not significantly better than that of male teachers, and their superior level is at a medium and low level, which is the highest among the three positions. However, the number of research samples is only 6, which may also be the reason for the high and insignificant value of this post. Further research and discussion can be conducted on the position of administrators.

(4) Strengthen related research in northeast and South China

In the study of geographical division, there is no corresponding literature support for Northeast and South China, so effective data cannot be obtained. The research samples from these regions may have been integrated into the sample number of nationwide sampling, or there is no research literature on the competence of college teachers in these regions, which can be further discussed in detail.

(5) Add more moderator variables

Through literature analysis, it can be seen that in the research of teachers' competence, age and teaching years also become influencing factors in some literatures. It may be considered to add age stage or coaching duration as new moderator variables to this study in subsequent research and conduct in-depth analysis.

The limit

The research has the following limitations: First, there is relatively little empirical data on the core layer of the Chinese college teachers' competence model, especially in the process of geographical division

analysis. Secondly, the research objects are mainly academic dissertations and journals, and few conference papers and unpublished literature are included, which may cause publication bias and affect the final meta-analysis results. Third, there are too few moderator variables. In the future, age or teaching age could be considered moderator variables to enrich the research content. Fourthly, in the geographical division of literature, there is a lack of data about northeast and South China, which makes it impossible to summarize the research results of these two regions. Fifthly, the number of research samples is uneven. There is a large gap in the number of samples taken in various studies, which may affect the final analysis results.

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