Correlations Between Teaching and Scientific Research Ability and Professional Development of College Teachers

https://doi.org/10.3991/ijet.v17i11.32031

Renguo Zhou
Scientific Research Office, Xiamen University of Technology, Xiamen, China
2010998102@xmut.edu.cn

Abstract—In the new era, the professional development (PD) of college teachers is significantly affected by their teaching and scientific research (TSR) ability. With a high TSR ability, teachers can enhance their professional literacy, explore the student behaviors in teaching practice, and optimize and improve the teaching mode. The research of college teachers' TSR ability has just started, lacking systematic, in-depth exploration. There is no report on the TSR subjects, or the effect of TSR ability on PD, not to mention empirical analysis of the correlations between TSR ability and PD. Therefore, this paper probes into the correlations between the TSR ability and PD of college teachers. Firstly, the data correlation principles were introduced for TSR ability and PD of college teachers, and an evaluation index system (EIS) was established for college teachers' TSR ability. Then, the scores of college teachers' TSR ability in a region were associated with the scores of college teachers' PD. On this basis, the nearest neighbor algorithm and the joint compatibility branch and bound (JCBB) algorithm were combined to derive an improved index data correlation model. Through experiments, the proposed model was proved effective, and the regional analysis results were obtained.

Keywords—college teachers, teaching and scientific research (TSR) ability, professional development (PD), correlation analysis

1 Introduction

In the new era, a high-quality team of teachers is necessary to train outstanding talents for the society [1-4]. The effective enhancement of college teachers' professional development (PD) directly bears on the training of new teachers into expert teachers, and guarantees high-quality teaching [5-9]. With the dawn of the new era, college teachers' professional literacy becomes increasingly diverse and complex. The PD of college teachers is significantly affected by their teaching and scientific research (TSR) ability [10-16]. College teachers must have an educational concept compatible with the reform and development of higher education, boast good classroom teaching ability and TSR ability, and support PD with these abilities [17-20]. Traditionally, college education aims to teach professional knowledge. By contrast, the PD behavior of college teachers

in the new era should be innovative. Education and scientific research are important aspects of the teachers' innovation ability. With a high TSR ability, teachers can enhance their professional literacy, explore the student behaviors in teaching practice, and optimize and improve the teaching mode.

On the relationship between teaching and scientific research, the traditional research ends up with many contradictory results, because the research data mainly come from the job performance of teachers. Based on the big data, Li et al. [21] proposed a research hypothesis different from that of traditional research. Targeting the details of teachers' TSR behaviors recorded in the educational big data system, the features of teachers' TSR behaviors were extracted by user portrait method. Then, the association rule mining algorithm was employed to derive the correlations between teaching behaviors and scientific research behaviors. Experimental results fully support their hypothesis, which effectively reveals the true relationship between teaching and scientific research. Zhang and Liu [22] highlighted that college teachers in the new era should do two things from the first day of work. The first is to stand on the podium and teach classes well. The other is to carry out scientific research, and write quality papers. The former is a basic requirement on teachers, and the latter is needed for teacher development. Both are indispensable.

In the era of big data and intelligent technology, it is very important and necessary to study the scientific research ability of college teachers. This ability is related to the development and progress of national education, and science and technology. Therefore, it is of great necessity to devise a smarter and more objective evaluation approach. After fully considering the above factors, Zhao and Sun [23] constructed a scientific ability evaluation model through analytic hierarchy process (AHP), which provides a reference for restoring the literacy of modern college teachers, and offers reasonable suggestions for teachers to pursue personal development. The progress of education is impossible without teacher development. High-quality education calls for high-quality teachers. Fu [24] adopted backpropagation (BP) neural network to appraise the teacher performance in applied colleges, and changed the appraisal method to guide the PD of teachers. With the aim to extend qualitative analysis to quantitative analysis, Zhao ang Sun [23] comprehensively considered various factors, assigned proper weights, and calculated by Mathematica. During this process, a specific evaluation model was developed for scientific research ability, which facilitates the literacy restoration of modern college teachers, and guides the reasonable development of each teacher.

The research of college teachers' TSR ability has just started, lacking systematic, in-depth exploration. Some studies only mention the teaching or scientific research ability of college teachers in the introductory part, failing to examine TSR subjects, or the effect of TSR ability on PD, not to mention empirical analysis of the correlations between TSR ability and PD. Therefore, this paper probes into the correlations between the TSR ability and PD of college teachers. Section 2 explains the data correlation principles for TSR ability and PD of college teachers, and establishes an evaluation index system (EIS) for college teachers' TSR ability. Section 3 associates the scores of college teachers' TSR ability in a region with the scores of college teachers' PD, constructs an improved index data correlation model based on the nearest neighbor algorithm and

the joint compatibility branch and bound (JCBB) algorithm, and analyzes the correlations between TSR ability and PD of college teachers. Through experiments, the proposed model was proved effective, and the regional analysis results were obtained.

2 Data correlation principles

In the new era, college teachers must possess the following basic skills and abilities, in order to meet various teaching needs:

1. The professional knowledge and skills necessary for teaching
   College teachers should master the basic strategies and skills for information teaching, curriculum activity design, and evaluation/appraisal of different types of students.
2. PD awareness and habit
   College teachers should always maintain good PD awareness and habit. They need to actively participate in academic training in related majors, keep a positive view of learning and progress, and frequently reflect on themselves.
3. Communication and exchanges with students and other teachers
   College teachers should be able to communicate and exchange effectively with students of different genders, races, religions, and gender orientations, and to discuss TSR topics with other teachers of different disciplines.
4. Identification as TSR subjects
   Apart from lecturing the knowledge in their field, college teachers should identify as TSR experts in their disciplines.

Currently, the reform and development of higher education in China requires college teachers to have a certain reserve of professional knowledge, a strong ability of information teaching, as well as the abilities to reflect on classroom teaching methods, and carry out the TSR in their disciplines. Teachers are the subjects responsible for developing school-based curriculums, based on intra- and extramural education resources. The development and integration of research courses rely on the organic integration between information technology and discipline teaching by college teachers. In other words, a key requirement for college teachers is the strong awareness and ability for TSR. Colleges must take the initiative to change the professional training model of teachers, and train a batch of new college teachers with TSR literacy, who can adapt to the reform and development of higher education in the new era.

This paper aims to fully analyze and explore the correlations between TSR ability and PD of college teachers, and verify the mutual promotion/inhibition between them, laying the basis for effective enhancement of college teachers' ability. Based on the research results, colleges can realize supervision and early warning of the TSR ability variation of their teachers, and maintain the college teachers' PD in the ideal range.

Referring to the existing EISs, this paper establishes the following EIS for college teachers' TSR ability:

Layer 1 (criteria layer):

TAS={TAS_1, TAS_2 , TAS_3}={TSR knowledge reserve, TSR capacity, TSR awareness};

Layer 2 (alternative layer)

TAS_1={TAS_{11}, TAS_{12}, TAS_{13}, TAS_{14}, TAS_{15}, TAS_{16}, TAS_{17}, TAS_{18}}={professional knowledge, professional skills, education principles, knowledge in teaching practice, information teaching technology, TSR methodology, education psychology, generation mechanism of research results};

TAS_2={TAS_{21}, TAS_{22}, TAS_{23}, TAS_{24}, TAS_{25}, TAS_{26}, TAS_{27}, TAS_{28}}={innovation ability, information retrieval ability, information mining ability, literature comprehension ability, literature summarization ability, TSR methodology utilization ability, data processing ability, research report writing ability};

TAS_3={TAS_{31}, TAS_{32}, TAS_{33}, TAS_{34}, TAS_{35}}={collaborative innovation spirit, enthusiasm for TSR, attitude towards academic misconduct, self-development awareness}.

Next, this paper associates the scores of college teachers' TSR ability in a region with the scores of college teachers' PD, and analyzes the data correlations between TSR ability and PD of college teachers. Figure 1 shows the data correlation principles for TSR ability and PD of college teachers.

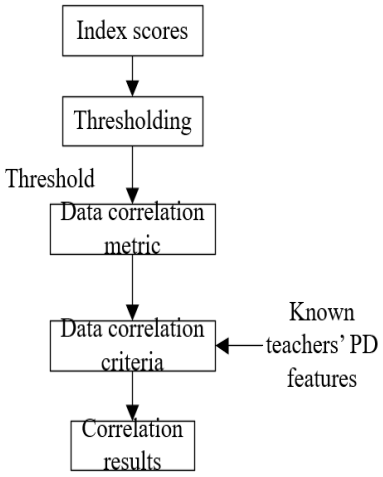

Fig. 1. Data correlation principles for TSR ability and PD of college teachers

3 Data correlation model

In each region, there are numerous scores of college teachers' TSR ability, and scores of college teachers' PD. The accuracy of data correlations depends on the evaluation index features at different time and locations. To ensure the correlation accuracy between TSR ability and PD of college teachers, this paper constructs an improved index data correlation model based on the nearest neighbor algorithm and the JCBB algorithm. Figure 2 shows the philosophy of the data correlation model.

The nearest neighbor algorithm is a simple and lightweight model. In this paper, the correlation between TSR ability and PD of college teachers is estimated by the shortest Euclidean distance between index score and subject features within the threshold. Based on this metric, the locations of the feature points of TSR ability and PD were corrected, before further estimating the location of the subject.

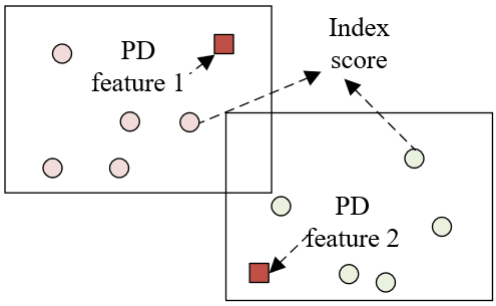

Fig. 2. Philosophy of the data correlation model

Let $c_i(l+1)$ be the score of the i-th index within the correlation threshold at time l+1 in the EIS; $c_i^*(l+1|l)$ be the predicted position of feature point correlation. Then, we have:

$$u_i(l+1) = c_i(l+1) - c_i^*(l+1|l) \tag{1}$$

Let $S(k+1)FC(l+1)$ be the covariance. Then, the norm can be expressed as:

$$h_i(l+1) = u_i^T(l+1)FC^{-1}(l+1)u_i(l+1) \tag{2}$$

The JCBB overcomes the incompleteness of test conditions, and improves the correlation accuracy of index data. Under the joint compatibility test condition, the compatibility between the scores is tested for the indices of the same class, in the light of the correlations between PD features of the subject. The difficulty of data correlation increases with the range of the study area. The JCBB reduces the joint compatibility of incorrect correlation between index data, making it more accurate to associate different data.

In the JCBB, the joint observation vector of known teachers' PD features for the indices of the same class can be expressed as:

$$c_{F_l} = \left[c_{F_1}, c_{F_2}, \ldots, c_{F_n}\right]^T \tag{3}$$

Let f_{Fl} be the observation model of the EIS. Then, the joint compatibility predicted observation c_{Fl}^* for teachers' PD features can be calculated by:

$$\hat{c}_{F_l} = f_{F_l}\left(A^{\wedge}_{l|l-1}\right) = \begin{bmatrix} f_{j_1}\left(A^{\wedge}_{l|l-1}\right) \\ g_{j_n}\left(A^{\wedge}_{l|l-1}\right) \end{bmatrix} \tag{4}$$

The information vector u_{Fl}, and its covariance matrix FC_{Fl} can be respectively calculated by:

$$u_{F_l} = C_{F_l} - f_{F_l}\left(A^{\wedge}_{l|l-1}\right) \tag{5}$$

$$FC_{F_l} = F_{F_l} T_{l|l-1} F^{T}{}_{F_l} + S_{F_l} \tag{6}$$

where,

$$F_{F_l} = \begin{bmatrix} F_{j1} \\ N \\ F_{j_n} \end{bmatrix} \tag{7}$$

$$F_{jn} = \frac{\partial f_{jn}}{\partial A_{l|l-1}} \left| A^{\wedge}_{l|l-1} \right. \tag{8}$$

Let 1-x be the expected confidence. The chi-square distribution ξ^2 is assumed as an e-dimensional matrix satisfying 1-x. Then, the joint compatibility data correlation criterion can be expressed as:

$$E^2_{v_l} = u^T_{F_l} R^{-1}_{F_l} u_{F_l} < \xi^2_{e,1-\beta} \tag{9}$$

The computing load of the algorithm grows exponentially with the rising index scores, and teachers' PD features. The exponential increase brings a huge impact on the accuracy of data correlations, and the analysis of data correlations.

Let N be the set of scores for the collected indices; N_{NEW} be the set of scores for the indices newly acquired at time l; N_{DA} be the set of scores for the indices with successful data correlations. Then, we have:

$$N = N_{NEW} \cup N_{DA} \tag{10}$$

Let P be the set of known teachers' PD features; P_{DA} be the set of indices in need of data correlation; P_{ELI} be the set of teachers' PD features, which do not need to be considered for associating the index data at time l. Then, we have:

$$P = P_{DA} \cup P_{ELI} \tag{11}$$

Let P_i of the teachers' PD features compatible with the index score i at time l. Then, we have:

$$P_{DA} = \bigcup_{i \in N_{DA}} P_i \tag{12}$$

For the elements in P_{DA} and N_{DA}, this paper searches for the optimal data correlations based on similarity, using the grey wolf optimization (GWO) algorithm, under the relevant constraints. The adopted likelihood function can be defined as:

$$KF = \bigcup_{\substack{n \in N_{DA} \\ m \in P_{DA}}} \Omega(c_n, g_m) \tag{13}$$

where,

$$\Omega(c_n, g_m) = \frac{1}{|2\pi R|^{\frac{1}{2}}} \exp\{[c_n - \hat{c}_m]^T R^{-1}[c_n - \hat{c}_m]\} \quad (14)$$

Formula (14) shows the probability for index score n to match teachers' PD feature m. Note that c_n is the index score of n; $\hat{c}_m$ is the estimation of m; R is the covariance of c_n-$\hat{c}_m$. Then, we have:

$$D_{nm} = -\ln[\Omega(c_n, g_m)] \quad (15)$$

Then, the minimum sum of the maximum number of D_{nm} can be found by transforming formula (14) with formula (15). In the combinatory optimization of index data correlations, it is a must to ensure that $n \in N_{DA}$, and $m \in P_{DA}$, and that, in d_{i1j1} and d_{i2j2}, i_1 is not equal to i_2, and j_1 is not equal to j_2. The improved index data correlation model can be implemented in the following steps:

Step 1. Initialize P_{DA}, N_{DA}, P_i and N_{NEW}.

Step 2. Construct the correlation matrix for evaluation indices.

Step 3. Preprocess the index data, search for elements satisfying A_{ij}=1 in the correlation matrix, match index score i with teachers' PD feature j, and remove the corresponding elements from P_{DA} and N_{DA}.

Step 4. Solve D_{ij}=$\sum_{i=1}^{n} L_i$, which depends on both N and P. Note that N_{DA}, P_i, and P_{DA} have n, L_i, and m elements, respectively.

Step 5. Compute the covariance distance N_{ij}, j=1,2,...,m between every index score i within the correlation threshold, and the known teachers' PD features. Note that every N_{ij} must satisfy:

$$\min_j N_{ij} > \alpha \quad (16)$$

Step 6. Ensure that the index score i is different from teachers' PD feature j in the set of solutions, i.e., guarantee that the subscripts of any two values in the set are independent of each other.

4 Experiments and results analysis

Figure 3 shows the success rate for the matching between the scores of 21 TSR ability indices and the known PD features of 2,000 college teachers, using the proposed index data correlation algorithm. Figure 4 shows the error in the matching of the index data during the operation of our model in a simulation environment. It can be seen that our model can effectively associate the index scores with college teachers' PD scores in the region.

Overall, the grand average and standard deviation of the TSR ability scores of the 2,000 subjects were 3.58, and 0.41, respectively. About 53.9% (1,248) college teachers stayed above the average, while 45.1% (915) stayed below the average. Table 1 lists the statistical and test results on college teachers' TSR ability.

As shown in Table 1, the grand average of college teachers' TSR ability fell between slightly good and strongly good in the scale, indicating that the college teachers possess a good TSR ability. Specifically, the highest average score (3.92) was achieved in the

dimension of TSR knowledge reserve. Thus, the college teachers in the region mostly have a certain TSR knowledge reserve. The second highest average score (3.59) was found in the dimension of TSR awareness. The lowest average score (3.34) was produced by TSR capacity, falling short of the threshold (3.5) for slightly good. Thus, the TSR capacity of the college teachers should be further enhanced. Table 1 also presents the single-sample t-test results on the three dimensions of college teachers' TSR ability. The results show that the p-values of all three dimensions, namely, TSR knowledge reserve, TSR capacity, and TSR awareness, were smaller than 0.05, and the t-values of all dimensions were all significant.

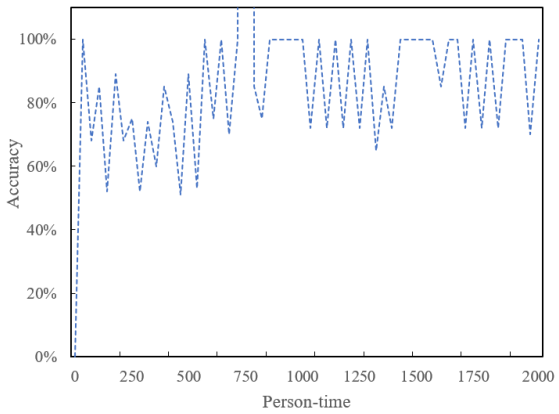

Fig. 3. Accuracy of index data correlations

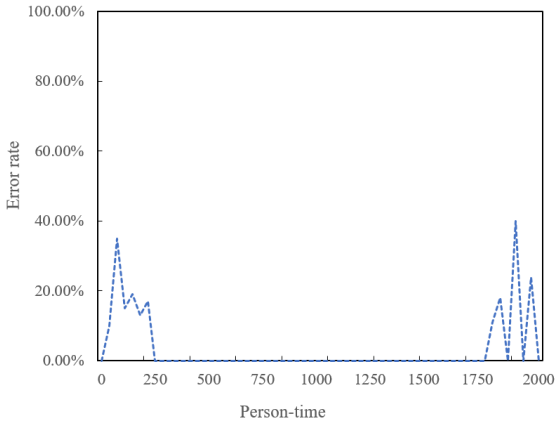

Fig. 4. Error rate of index data correlations

Table 1. Statistical and test results on college teachers' TSR ability

Dimension	Total	TSR knowledge reserve	TSR capacity	TSR awareness
Average	3.58	3.92	3.34	3.59
Standard deviation	0.41	0.35	0.52	0.57
T	11.53	12.37	-16.05	13.17
P	0.02	0.05	0.01	0.04
Below the average	915(45.1%)	948(49.2%)	864(42.7%)	1126(52.4%)
Above the average	1248(53.9%)	1436(51.8%)	1294(57.3%)	972(47.6%)

The three dimensions of college teachers' TSR ability have different functions and merits in practice. To reveal the correlations between TSR ability and PD of college teachers, it is insufficient to evaluate, judge, and compare the three dimensions of college teachers' TSR ability, solely based on the average. This paper decides to compare the number of college teachers below the average and that above the average in each dimension. Figure 5 shows the distribution of college teachers' TSR ability in each dimension. It can be seen that, there were more below-the-average college teachers than above-the-average teachers in TSR capacity and TSR knowledge reserve. The opposite was observed in TSR awareness. Judging by the total score, fewer college teachers surpassed the average than those remaining below the average. Although the college teachers in the region have a high grand score of TSR ability, the proportion of below-the-average teachers indicates the necessity of further enhancing the education and research ability. This is consistent with the conclusions of previous studies.

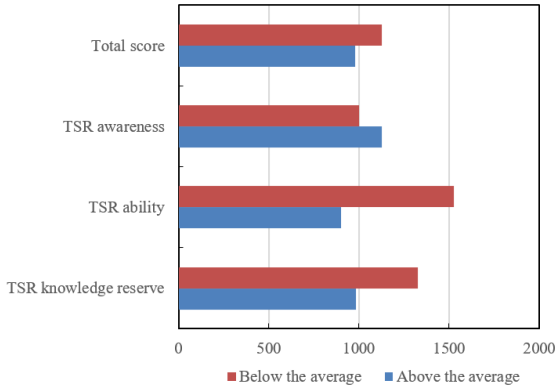

Fig. 5. Distribution of college teachers' TSR ability in each dimension

Tables 2 and 3 summarize the correlations between the three dimensions of TSR ability and the PD of college teachers. As shown in Table 2, for the regional college teachers, the average correlation between each of the eight aspects of TSR knowledge reserve (professional knowledge, professional skills, education principles, knowledge in teaching practice, information teaching technology, TSR methodology, education psychology, and generation mechanism of research results) and the PD was greater than 3. Thus, the regional college teachers have an ideal PD situation, under the effects of

these indices. Of course, the correlation scores of the eight aspects differed slightly, indicating that the subjects develop by different degrees in each direction of TSR ability. This means, the PD of regional college teachers is greatly affected by the subjects' TSR knowledge reserve, and the evaluation alternatives of TSR knowledge reserve should be more balanced.

As shown in Table 3, for the regional college teachers, the average correlation between each of the eight aspects of TSR capacity (innovation ability, information retrieval ability, information mining ability, literature comprehension ability, literature summarization ability, TSR methodology utilization ability, data processing ability, and research report writing ability) and the PD was greater than 3; the average correlation between each of the four aspects of TSR awareness (collaborative innovation spirit, enthusiasm for TSR, attitude towards academic misconduct, and self-development awareness) and the PD was greater than 3, too. These results confirm that regional college teachers have an ideal PD situation, under the effects of these indices. It can also be learned that the college teachers' PD in the region is significantly affected by TSR capacity, and TSR awareness. But the alternatives of evaluation should be further balanced in future.

Table 2. Correlations between TSR knowledge reserve and PD of college teachers

	Sample size	**Average**	**Standard deviation**	**Mean standard error**
Professional knowledge	174	3.68	7.61	0.51
Professional skills	168	3.16	7.87	0.58
Education principles	172	4.27	8.69	0.62
Knowledge in teaching practice	169	4.05	7.64	0.67
Information teaching technology	174	3.92	7.05	0.63
TSR methodology	169	3.75	6.37	0.59
Education psychology	173	3.81	6.29	0.64
Generation mechanism of research results	171	3.95	6.84	0.66

Table 3. Correlations between TSR capacity, TSR awareness, and PD of college teachers

	Sample size	**Average**	**Standard deviation**	**Mean standard error**
Innovation ability	179	3.62	8.42	0.68
Information retrieval ability	165	3.17	7.95	0.52
Information mining ability	172	4.28	7.52	0.57
Literature comprehension ability	176	3.69	7.63	0.51
Literature summarization ability	168	3.47	7.98	0.59
TSR methodology utilization ability	171	3.05	7.46	0.55
Data processing ability	169	3.82	7.38	0.52
Research report writing ability	174	3.46	7.21	0.57
Collaborative innovation spirit	162	3.71	7.46	0.53
Enthusiasm for TSR	178	3.86	7.05	0.51
Attitude towards academic misconduct	177	4.38	6.81	0.55
Self-development awareness	177	4.37	8.59	0.68

5 Conclusions

This paper explores the correlations between the TSR ability and PD of college teachers. Firstly, the authors expounded on the data correlation principles for TSR ability and PD of college teachers, and built up an EIS for college teachers' TSR ability. Then, the scores of college teachers' TSR ability in a region were associated with the scores of college teachers' PD, and an improved index data correlation model was established based on the nearest neighbor algorithm and the JCBB. After that, experiments were carried out to obtain the accuracy and error rate of our model in index data correlations. It was found that our model can effectively associate the index scores with college teachers' PD scores in the region. Next, the authors summed up the statistical and test results on college teachers' TSR ability, as well as the distribution of college teachers' TSR ability in each dimension. The overall correlations between PD and each dimension of college teachers' TSR ability (TSR knowledge reserve, TSR capacity, and TSR awareness) were also summarized. It was concluded that the college teachers' PD in the region is significantly affected by the three dimensions of TSR ability. But the alternatives of evaluation should be further balanced in future.

6 Acknowledgment

Establishment and Research on the Implementation Model of Science and Technology Patents in Colleges and Universities; Grant No.: JAT190687.

7 References

[1] Kong, X.F. (2017). The status quo and countermeasures of the construction of the double-qualified teacher team in maritime vocational colleges. AGRO Food Industry Hi-Tech, 28(3): 1045-1049.

[2] Zhao, F.H., Guo, X.F., He, Y. (2014). The study and practice of constructing featured specialty based on the double qualified teacher and double mentors. In Advanced Materials Research, 971: 2685-2687. https://doi.org/10.4028/www.scientific.net/AMR.971-973.2685

[3] Zhang, N. Zhang, Y. (2012). Evolution and tendency to" double-qualified" teacher competency: A literature review on Chinese higher vocational education. 2012 Fourth International Conference on Multimedia Information Networking and Security, pp. 529-532. https://doi.org/10.1109/MINES.2012.109

[4] Li, H.D., Lin, C.L. (2019). Research on the ability evaluation of" Double-qualified and double-ability" teacher in M university based on fuzzy-AHP. In 2019 15th International Conference on Computational Intelligence and Security (CIS), pp. 292-295. https://doi.org/10.1109/CIS.2019.00068

[5] Friend, M., Twarek, B., Koontz, J., Bell, A., Joseph, A. (2022). Trends in CS Teacher Professional Development: A Report from the CSTA PD Committee. In Proceedings of the 53rd ACM Technical Symposium on Computer Science Education, pp. 390-396. https://doi.org/10.1145/3478431.3499292

[6] Gunning, A.M., Marrero, M.E., Larson, K.V. (2021). Studying In-service Teacher Professional Development on Purposeful Integration of Engineering into K-12 STEM

Teaching (Research to Practice). In 2021 ASEE Virtual Annual Conference Content Access.
[7] Riel, J., Lawless, K.A. (2022). Enhancing student affect from multi-classroom simulation games via teacher professional development: Supporting game implementation with the ROPD model. In Research Anthology on Developments in Gamification and Game-Based Learning, pp. 1703-1725. https://doi.org/10.4018/978-1-6684-3710-0.ch083
[8] Chen, G. (2020). A visual learning analytics (VLA) approach to video-based teacher professional development: Impact on teachers' beliefs, self-efficacy, and classroom talk practice. Computers & Education, 144: 103670. https://doi.org/10.1016/j.compedu.2019.103670
[9] Yang, R., Porter, A.C., Massey, C.M., Merlino, J.F., Desimone, L.M. (2020). Curriculum-based teacher professional development in middle school science: A comparison of training focused on cognitive science principles versus content knowledge. Journal of Research in Science Teaching, 57(4): 536-566. https://doi.org/10.1002/tea.21605
[10] Guo, S.Y., Wu, W.C., Cai, A.T. (2020). A study on promoting teachers' professional quality to achieve sustainable development goals. In IOP Conference Series: Earth and Environmental Science, 576(1): 012013. https://doi.org/10.1088/1755-1315/576/1/012013
[11] Chiu, C.F. (2020). Facilitating K-12 Teachers in Creating Apps by Visual Programming and Project-based Learning, International Journal of Emerging Technologies in Learning, 15(3): 103-118. https://doi.org/10.3991/ijet.v15i01.11013
[12] Li, Y.X. (2015). Study on special education teachers' professional quality based on the survey data analysis. In 2015 Seventh International Conference on Measuring Technology and Mechatronics Automation, pp. 1066-1071. https://doi.org/10.1109/ICMTMA.2015.260
[13] Kong, F.W. (2020). Evaluation Model of Adaptive Teaching Ability of College Art Teachers, International Journal of Emerging Technologies in Learning, 15(9): 143-155. https://doi.org/10.3991/ijet.v15i09.14031
[14] Zhao, X., Guo, Z., Liu, S. (2021). Exploring key competencies and professional development of music teachers in primary schools in the era of artificial intelligence. Scientific Programming. https://doi.org/10.1155/2021/5097003
[15] Chen, Z., Chen, Q. (2021). Optimization of teaching evaluation system for football professional teachers based on multievaluation model. Complexity. https://doi.org/10.1155/2021/9943989
[16] Goode, J., Peterson, K., Malyn-Smith, J., Chapman, G. (2020). Online professional development for high school computer science teachers: Features that support an equity-based professional learning community. Computing in Science & Engineering, 22(5): 51-59. https://doi.org/10.1109/MCSE.2020.2989622
[17] Asnawati, S., Dewi, I.L.K. (2020). Mathematical representation ability using website for learning transformation geometry in a teacher education classroom. In Journal of Physics: Conference Serie, 1511(1): 012115. https://doi.org/10.1088/1742-6596/1511/1/012115
[18] Tang, M., Wei, D. (2021). Cultivation Strategies for Scientific Research and Innovation Ability of College Students Majoring in Sports. International Journal of Emerging Technologies in Learning, 16(6): 154-166. https://doi.org/10.3991/ijet.v16i06.21093
[19] Reynolds, W.M., Park, S. (2021). Examining the relationship between the Educative Teacher Performance Assessment and preservice teachers' pedagogical content knowledge. Journal of Research in Science Teaching, 58(5): 721-748. https://doi.org/10.1002/tea.21676
[20] Chen, S.Y., Wang, T.H., Li, X.M., Zhu, L., Wu, D.Y. (2021). Research on the improvement of teachers' teaching ability based on machine learning and digital twin technology. Journal of Intelligent & Fuzzy Systems, 40(4): 7323-7334. https://doi.org/10.3233/JIFS-189557
[21] Li, Y., Fu, H., Tang, Y., Fu, C. (2019). Empirical research on the relationship between teaching and scientific research based on educational big data in China. In CCF Conference

on Computer Supported Cooperative Work and Social Computing, pp. 390-398. https://doi.org/10.1007/978-981-15-1377-0_30

[22] Zhang, Y., Liu, W. (2021). University teachers improve teaching by doing scientific research. In The Sixth International Conference on Information Management and Technology, pp. 1-4. https://doi.org/10.1145/3465631.3465953

[23] Zhao, C., Sun, Z. (2021). Study on the Evaluation of Scientific Research Ability of University Teachers Based on the Mathematica Software. In 2021 2nd International Conference on Big Data and Informatization Education (ICBDIE), pp. 334-338. https://doi.org/10.1109/ICBDIE52740.2021.00082

[24] Fu, G. (2020). Evaluation strategy of teacher professional development in applied universities based on BP neural network. In International Conference on Application of Intelligent Systems in Multi-modal Information Analytics, pp. 479-486. https://doi.org/10.1007/978-3-030-51431-0_70

8 Author

Renguo Zhou is an Assistant Researcher of Xiamen University of Technology. He has received his Master Degree of Rural and Regional Economy in Jimei University, Xiamen. His research interests include Scientific Research Management, Transformation of Scientific and Technological Results, Intelligent Information Processing (email: 2010998102@xmut.edu.cn).

Article submitted 2022-03-27. Resubmitted 2022-04-28. Final acceptance 2022-04-28. Final version published as submitted by the author.