

## APPLYING RANK-SUM METHOD TO DETERMINE THE IMPORTANCE OF THE EVALUATION CRITERIA IN THE "SET OF EVALUATION CRITERIA ON NEW MIDDLE SCHOOL PHYSICAL EDUCATION TEACHER IN VIETNAM

## LE CAT NGUYEN<sup>1</sup>; LE THI BICH DAO<sup>2</sup>

<sup>1</sup>Postgraduate at School of Physical Education and Sports, Central China Normal University, Wuhan, China. <sup>2</sup> Faculty of Physical Education, Hue University, Vietnam

## Abstract

The set of evaluation criteria includes the evaluation standards (level I criterion), there are the evaluation criteria in each evaluation standard (level II criterion) and evaluation indicators (level III criterion) in each evaluation criterion. The role and importance of the evaluation criterion at each level varies. To determine the importance of the evaluation criterion at each level, in addition to the opinions of experts, this paper on Rank-Sum Method is used to calculate the weights of evaluation criterion at each level, thereby determine the importance of each criterion in the set of evaluation criteria.

**Keywords:** Rank-Sum method, weights, evaluation criteria, physical education teacher (PET).

#### **1. Introduction**

Evaluation of physical education teacher (PET) is part of the evaluation of teachers. If being performed well, evaluation of PET will contribute to improve the quality of the physical education teachers, thereby contributing to improve the effectiveness of physical education (PE). Despite such an important role, in Vietnam, evaluation of PET has not been paid an adequate attention, the effectiveness of evaluation of PET is still very low and one of the main reasons is that Vietnam currently has had no separate set of evaluation of PET. Through the research, the author has surveyed and analyzed the current situation of PET in Vietnam. From that, the author combined them with the analysis of the theoretical and practical background of the evaluation of teachers in general as well as evaluation of PET in particular and simultaneously used different research methods for the building of the evaluation criteria on current graduated secondary physical education teachers in Vietnam includes 4 standards, 19 criteria and 50 indicators (see table 2). Each evaluation criterion has different roles and level of importance. This paper on Rank-Sum method to calculate the weights of the evaluation criteria will determine the importance of each criterion. This is an important basis to the physical education teachers and the evaluation of PET Board to analyze the results of the evaluation, which identifies the strengths and the limitations of the assessed teachers and contributes to the evaluation of PET effectively.

#### 2. Materials and Methods

To determine the weight of evaluation criteria, there are different methods such as Hierachy Analysis Process (AHP), Delphi method, Rank-sum method, paired comparison, method for expert opinion elicitation and weighted argument systems. Each method has its own advantages and disadvantages. In this paper, the authors used the Rank-Sum method to determine the weights of evaluation criteria.

Rank-Sum method is originally called in Chinese 秩和运算法 (also known as 专家排序法) by a professor of Beijing Normal University, Cheng Shuxiao, proposed in 1989. This method uses surveys to solicit the opinions of the experts on the level of importance of the evaluation criteria. Experts will depend on the level of importance of the evaluation criterion for conducting sequencing their ratings, specifically as follows: Supposing that there are n experts polled to sort of importance of m criteria in the set of evaluation criteria, the most important criterion by experts ranks 1, the second most important criterion ranks 2, etc. and

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## AARJSH VOLUME 3 ISSUE 9 (SEPTEMBER 2016) ISSN : 2278 – 859X

the the least important criterion ranks m. If some criteria ranks equally important, then the average of the sequence numbers ranked are counted as the final sequence number (for example, there are two criteria ranked 1, then the sequence number of the two criteria is 1.5 and the next important criterion ranks 3). The sequence number that n experts rank for each criterion will constitute 1 line of numbers; adding all the numbers of the line, we have the total sequence number ranked of the criterion, denoted by R.

The formula for calculating weights as follows:

 $W_i = \frac{2[(m+1)n-R_i]}{mn(m+1)} (i=1,2,3,...,m)$  (Formula I)

Where  $W_i$  is the weight of criterion number i;  $R_i$  is the total order of ranking of criterion number i; m is the total number of criteria in the same level; n is the number of experts.

The formula for calculating the priority weights of level II and III criteria:

Priority weights of level II criteria = specific weight × weight of respective criterion 1 (Formula II)

Priority weights of level III criteria= specific weight × weight of respective criterion 2 (Formula III).

An important requirement when using this method is the opinion of experts must meet the requirement of consistency, otherwise the weight calculations will not be meaningful. Therefore, before calculationthe weight of evaluation criteria, we have to check the consistency of the comments of the experts. The formula to check the consistency of the experts is as follows:

 $X^{2} = \frac{\sum Ri^{2} - (\sum Ri)^{2}/m}{1/12mn(m+1)}$  (Formula IV)

As if  $X^2$  (chi-square)  $\ge X^2_{0.01}$  (m-1) (*m* is the number of criteria in the same level), then, it can be concluded that the opinions of the experts are consistency, so it can be proceed to the next step; as if  $X^2 < X^2_{0.01}$  (m-1), then, the opinions of the experts fail to meet requirements of consistency, there should be an exchange, discussion to achieve greater consistency.

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#### 3. Results and Discussion

# **3.1.** Calculation on weight of criteria in the "set of evaluation criteria on new middle school physical education teacher in Vietnam".

Through the research, the author developed the evaluation criteria including 4 standards (level I criterion), they are: "The qualities and fundamentals", "Working capacity", "Working efficiency" "Career development capacity"; 19 criteria (level II criterion) and 50 indicators (level III criterion). The author interviewed 71 experts to conduct the rating on the importance of each criterion, then used rank-sum method to calculate the weight of each evaluation criterion.

Author will implement specific steps for calculating the level I criterion, the level II and III criterion will be proceeded similarly.

We have the number of level I criterion is m = 4, the number of experts interviewed is n = 71, the order of the criteria ranked by experts is shown in Table 1.

|         | Rankings                          |                     |                       |                                      |  |  |
|---------|-----------------------------------|---------------------|-----------------------|--------------------------------------|--|--|
| Experts | 1. The qualities and fundamentals | 2. Working capacity | 3. Working efficiency | 4. Career<br>development<br>capacity |  |  |
| P1      | 2                                 | 1                   | 3                     | 4                                    |  |  |
| P2      | 2                                 | 3                   | 1                     | 4                                    |  |  |
| P3      | 1                                 | 2                   | 3                     | 4                                    |  |  |
| P4      | 4                                 | 2                   | 1                     | 3                                    |  |  |
| P5      | 1.5                               | 1.5                 | 3                     | 4                                    |  |  |
| P6      | 3                                 | 1                   | 2                     | 4                                    |  |  |
| P7      | 1                                 | 2                   | 3                     | 4                                    |  |  |
| P8      | 4                                 | 1                   | 2                     | 3                                    |  |  |
| P9      | 2                                 | 1                   | 3                     | 4                                    |  |  |
| P10     | 3                                 | 1                   | 2                     | 4                                    |  |  |
| P11     | 1                                 | 3                   | 2                     | 4                                    |  |  |
| P12     | 1                                 | 2                   | 3                     | 4                                    |  |  |
| P13     | 4                                 | 1                   | 2                     | 3                                    |  |  |
| P14     | 1                                 | 3                   | 2                     | 4                                    |  |  |
| P15     | 1                                 | 2                   | 3                     | 4                                    |  |  |
| P16     | 2                                 | 1                   | 3                     | 4                                    |  |  |
| P17     | 1                                 | 2                   | 3                     | 4                                    |  |  |
| P18     | 4                                 | 1                   | 3                     | 2                                    |  |  |
| P19     | 1.5                               | 1.5                 | 3                     | 4                                    |  |  |
| P20     | 3                                 | 1                   | 2                     | 4                                    |  |  |
| P21     | 3                                 | 1                   | 2                     | 4                                    |  |  |

 Table 1: 71 experts ranking the importance of the level I criteria

Asian Academic Research Journal of Social Sciences & Humanities www.asianacademicresearch.org

VOLUME 3 ISSUE 9

(SEPTEMBER 2016)

ISSN : 2278 – 859X

| DJJ | 15            | 15                | 2        | 1                 |
|-----|---------------|-------------------|----------|-------------------|
| P22 | 1.5           | 1.5               | 2        | 4                 |
| P23 | 1             | 2                 |          | 4                 |
| P24 | 3             | 4                 | 1        | <u> </u>          |
| P25 | 1             | 3                 | <u> </u> | 4                 |
| P26 | 1             | 3                 | 4        | 2                 |
| P27 | 2             | 1                 | 3        | 4                 |
| P28 | 4             | 1                 | 2        | 3                 |
| P29 | 2             | 1                 | 3        | 4                 |
| P30 | 1             | 3                 | 4        | 2                 |
| P31 | 2             | 3                 | 1        | 4                 |
| P32 | 2             | 1                 | 3        | 4                 |
| P33 | 1             | 2                 | 3        | 4                 |
| P34 | 2             | 1                 | 3        | 4                 |
| P35 | 1             | 3                 | 4        | 2                 |
| P36 | 2             | 1                 | 3        | 4                 |
| P37 | 1             | 2                 | 3        | 4                 |
| P38 | 3             | 1                 | 2        | 4                 |
| P39 | 1             | 2                 | 4        | 3                 |
| P40 | 1             | 4                 | 2        | 3                 |
| P41 | 2             | 3                 | 1        | 4                 |
| P42 | 2             | 1                 | 3        | 4                 |
| P43 | 2             | 1                 | 3        | 4                 |
| P44 | 1.5           | 3.5               | 1.5      | 3.5               |
| P45 | 2             | 1                 | 3        | 4                 |
| P46 | 2             | 1                 | 3        | 4                 |
| P47 | 1             | 3                 | 3        | 3                 |
| P48 | 1             | 2                 | 3        | 4                 |
| P49 | 1             | 4                 | 2        | 3                 |
| P50 | 2             | 1                 | 3        | 4                 |
| P51 | 1             | 2                 | 3        | 4                 |
| P52 | 1             | 2                 | 4        | 3                 |
| P53 | 4             | 1.5               | 1.5      | 3                 |
| P54 | 2             | 1                 | 3        | 4                 |
| P55 | 1             | 2                 | 3        | 4                 |
| P56 | 4             | 1.5               | 1.5      | 3                 |
| P57 | 2             | 1                 | 3        | 4                 |
| P58 | 1             | 2                 | 3        | 4                 |
| P59 | 3             | 1                 | 2        | 4                 |
| P60 | 2             | 1                 | 3        | 4                 |
| P61 | 1             | 2                 | 3        | 4                 |
| P62 | 2             | 1                 | 3        | 4                 |
| P63 | 2             | 35                | 1        | 3.5               |
| P64 | <u>2</u><br>4 | 1                 | 2        | 3                 |
| P65 | 1             | 3                 | 2        | 4                 |
| P66 | 2             | 1                 | 2 3      | <u>т</u><br>Д     |
| P67 | 2             | 1                 | 3        | 4                 |
| P68 | 1             | 2                 | 3        | <del>т</del><br>Л |
| D60 | 1             | <u> </u>          | <u> </u> | 2                 |
| D70 | 2             | <del>4</del><br>1 | 2        | ЗЛ                |
| D71 | 2             | 2                 | J<br>1   | <u>+</u><br>Л     |
| F/1 | <u> </u>      | 3                 | 1        | 4                 |
| Ri  | 136           | 131.5             | 182.5    | 260               |

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Firstly, the author will examine the consistency of the responses of the experts by the formula IV:

$$X^{2} = \frac{\sum Ri^{2} - (\sum Ri)^{2}/m}{1/12mn(m+1)} = \frac{(136^{2} + 131.5^{2} + 182.5^{2} + 260^{2}) - (136^{2} + 131.5^{2} + 182.5^{2} + 260^{2})^{2}/4}{1/12.4.71(4+1)} = 90,164$$

Looking for the Chi-square distribution table, it is concluded that:

$$X_{0.01}^2(m-1) = X_{0.01}^2(4-1) = 11.34$$

Therefore,  $X^2 = 90,164 > X^2_{0.01}(m-1) = 11,34$ . Through the test results, it is showed that the opinions of experts met the requirement of consistency.

Next, we applied the formula to calculate the Weight of Level I Criterion.

Considering  $W_1, W_2, W_3, W_4$  respectively Weight of Criteria "the qualities and fundamentals", "working capacity", "working efficiency", "career development capacity". It is concluded that:

$$W_{1} = \frac{2[(4+1)71 - 136]}{4.71(4+1)} = 0.308$$

$$W_{2} = \frac{2[(4+1)71 - 131.5]}{4.71(4+1)} = 0.315$$

$$W_{3} = \frac{2[(4+1)71 - 182.5]}{4.71(4+1)} = 0.243$$

$$W_{4} = \frac{2[(4+1)71 - 260]}{4.71(4+1)} = 0.134$$

It is concluded that Weights of level I evaluation Criteria respectively are: 0.308, 0.315, 0.243, 0.134.

Apply the same calculation with level II and III evaluation criteria, weight of criteria in the "set of evaluation criteria on new middle school physical education teacher in Vietnam" is shown as follows in Table 2:

 Table 2: Weight of criteria in the ''set of evaluation criteria on new middle school physical education teacher in Vietnam ''

| Weight of<br>Standards  | Weight of Criteria                   | Priority<br>weights | Weight of Indicators                            | Priority<br>weights |
|---|--------------------------------------|---------------------|---|---------------------|
| 1.<br>The<br>qualities<br>and<br>fundamentals<br><b>0.308</b> | 1.1. Moral political qualities 0.255 | 0.079               | 1.1.1. Political qualities 0.423                | 0.033               |
|   |                                      |                     | 1.1.2. Ethics 0.577                             | 0.046               |
|   | 1.2. Lifestyle 0.168                 | 0.052               | 1.2.1. Lifestyle, behavior 0.54                 | 0.028               |
|   |                                      |                     | 1.2.2. Dealing with students, colleagues 0.46   | 0.024               |
|   | 1.3. Basic knowledge 0.21            | 0.065               | 1.3.1. Foreign Language – IT<br>knowledge 0.488 | 0.032               |

Asian Academic Research Journal of Social Sciences & Humanities www.asianacademicresearch.org



## AARJSH

VOLUME 3 IS

ISSUE 9 (SEPTEMBER 2016)

ISSN : 2278 – 859X

|          |  |       | 1.3.2. General knowledge 0.512                    | 0.033 |
|----------|--|-------|---|-------|
|          | 1.4.Health-SpiritualStatus0.166                                  | 0.051 | 1.4.1. Health status 0.596                        | 0.03  |
|          |  |       | 1.4.2. Spiritual status 0.404                     | 0.021 |
|          | 1.5 Ability to express   | 0.062 | 1.5.1. Ability to express 0.624                   | 0.039 |
|          | and communicate 0.2  | 0.002 | 1.5.2. Ability to communicate pedagogically 0.376 | 0.023 |
|          |  |       | 2.1.1. Developing teaching plan 0.219             | 0.018 |
|          |  | 0.081 | 2.1.2. Ensuring subject knowledge                 |       |
|          | 2.1. Teaching capacity 0.257                                     |       | 0.217   | 0.018 |
|          |  |       | 2.1.3. Ensuring curriculum 0.178                  | 0.014 |
|          |  |       | 2.1.4. Applying and using the training            | 0.014 |
|          |  |       | equipment 0.1/2                                   | 0.014 |
|          | 2.2. Education<br>capacity 0.19                                  |       | environment 0 105                                 | 0.000 |
|          |  |       | 2 1 6 Checking study results 0 109                | 0.009 |
|          |  |       | 2.2.1. The ability to learn about the subject and | 0.007 |
|          |  |       | educational environment 0.234                     | 0.014 |
|          |  |       | 2.2.2. Constructing educational                   |       |
|          |  |       | activity plan 0.290                               | 0.017 |
|          |  | 0.06  | 2.2.3. Education through courses and              | 0.014 |
|          |  |       | extracurricular activities 0.239                  |       |
|          |  |       | 2.2.4. Applying the principles, methods           | 0.014 |
| 2        |  |       | and forms of educational operation $0.237$        | 0.014 |
| Teaching | 2.3. Expertise<br>knowledge 0.241                                | 0.076 | 2.3.1. Knowledge of the theory and                | 0.000 |
| capacity |  |       | methods of Physical Education 0.366               | 0.028 |
| 0.315    |  |       | 2.3.2. Knowledge of teaching methods              | 0.032 |
|          |  |       | and practice in sports 0.423                      | 0.032 |
|          |  |       | 2.3.3. Related knowledge 0.211                    | 0.016 |
|          | <ul><li>2.4. Extracurricular activities capacity 0.108</li></ul> | 0.034 | 2.4.1. Ability to organize extra-                 | 0.01  |
|          |  |       | 2.4.2 Ability to organize sport                   |       |
|          |  |       | activities 0.195                                  | 0.007 |
|          |  |       | 2.4.3. The ability to recruit and train           |       |
|          |  |       | 0.213   | 0.007 |
|          |  |       | 2.4.4. Arbitration capabilities 0.173             | 0.006 |
|          |  |       | 2.4.5. Union participation ability                | 0.004 |
|          |  |       | 0.132   | 0.001 |
|          | 2.5. Ability to practice <b>0.04</b> the sports 0.126            | 0.04  | 2.5.1. Ability to make a model                    | 0.026 |
|          |  | 0.04  | 0.038   |       |
|          |  |       | competition 0.362                                 | 0.014 |
|          | 2.6. Research Capacity 0.025                                     |       | 2.6.1. Knowledge of Research 0.531                | 0.013 |
|          |  | 0.025 | 2.6.2. Attitudes involved in scientific           | 0.012 |
|          |  |       | research 0.469                                    | 0.012 |
| 3.       | 3.1. Teaching  |       | 3.1.1. Ensuring teaching time 0.293               | 0.023 |
| Working  | effectiveness 0.319  | 0.078 | 3.1.2. Ensuring the content,                      | 0.032 |

Asian Academic Research Journal of Social Sciences & Humanities

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AARJSH

VOLUME 3

ISSUE 9 (SEPTEMBER 2016)

ISSN: 2278 - 859X

| efficiency                                     |   |       | curriculum 0.411   |       |
|--|---|-------|--|-------|
| 0.243  |   |       | 3.1.3. Achievements 0.296  | 0.023 |
|  | 3.2. Proficiency of education 0.263                             | 0.064 | 3.2.1. Understanding of students and social issues related 0.460           | 0.029 |
|  |   |       | 3.2.2. Detecting emerging issues and measures 0.540                        | 0.035 |
|  | 3.3. Efficiency of extracurricular activity                     | 0.043 | 3.3.1. The process of participating in extracurricular activities 0.413    | 0.018 |
|  | participation 0.175   |       | 3.3.2. Achievements 0.587  | 0.025 |
|  | 3.4. Efficiency of research 0.131                               | 0.032 | 3.4.1. The process of involving in scientific research 0.54                | 0.017 |
|  |   |       | 3.4.2. Achievements 0.46   | 0.015 |
|  | 3.5. Efficiency of <b>0.02</b> '                                | 0.027 | 3.5.1. The process of involving in of social activity participation 0.451  | 0.012 |
|  | participation 0.112   |       | 3.5.2. Efficiency of involving in of social activity participation 0.549   | 0.015 |
| 4. Career<br>developme<br>nt capacity<br>0.134 | 4.1. Self-evaluation,<br>self-study and self-<br>practice 0.434 | 0.058 | 4.1.1.The sense of self-evaluation, self-learning and self-practice 0.399  | 0.023 |
|  |   |       | 4.1.2. The habit of self-evaluation, self-learning and self-practice 0.601 | 0.035 |
|  | 4.2. Ability to learn, to                                       | 0.043 | 4.2.1. Practicing to advancethe knowledge 0.376                            | 0.016 |
|  |   |       | 4.2.2. Fostering professional 0.420  | 0.018 |
|  | 00 10stered 0.522   |       | 4.2.3. Combining Teaching and Research 0.204                               | 0.009 |
|  | 4.3. Ability to   | 0.022 | 4.3.1. With colleagues 0.455   | 0.015 |
|  | communicate and cooperate 0.244                                 | 0.035 | 4.3.2. With parents and students 0.521                                     | 0.017 |

#### 3.2. Discussion

The result of calculating the weights of evaluation standards (level I criterion), it can be shown that the experts ranked the standard "Working capacity" the highest level of importance, followed by the standard "The qualities and fundamentals", standard "Working efficiency" with an importance of 3, and the standard "Career development capacity" ranked by the experts the least important among the 4 standards.



For the evaluation criteria (level II criterion), results of the weights ofthe calculation showed that the criterion "Teaching capacity" is the most important (0.081), followed by the criterion "political moral qualities" and the criterion "Teaching effectiveness" respectively number 2 and 3, however the importance of these criteria are almost equal when they have the weights of 0.079 and 0.078. Criterion "Expertise knowwledge" ranked by the experts number 4 (0.076), criterion"Basic knowledge"ranked number 5 (0.065). Two criteria "Research Capacity" and "Socio-political activity participation effectiveness" ranked the lowest level of importance with the weights of 0.025 and 0.027 respectively.

For the evaluation indicators (level III criterion), the experts ranked the indicator "Ethics" is the most important (0.046), the indicator "Ability to express" is considered number 2 (0.039). With the equal weight of 0.035, 2 indicators "Self-evaluation, self-study and self-practice" and "Detecting problems arise and measures" ranked number 3 while indicator " Union participation capacity" with a weight of 0.004 ranked the least important.

## 4. Conclusion

The study result showed that the evaluation criteria relating to political moral qualities, Teaching capacity, Teaching effectiveness and efficiency of education, sense of self-learning and training is consistently ranked the most important. Where as the evaluation criteria related to scientific research issues, participating in social-political activitiess, Union activities are considered the least important criteria. Comparing research results with practical professional activities of physical education teachers in Vietnam as well as provisions on the functions, duties and political moral qualities of the teachers in generaland physical education teachers in particular, it can be concluded that the analysis of the importance of evaluation criteria based on the results of weight byrank-sum method gave quite accurate and reasonable results. This is an important basis to the physical education teachers and the evaluation of PET Board to analyze the results of the evaluation, which identifies the strengths and the limitations of the assessed teachers and contributes to the evaluation of PET effectively.

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