

# Employment Mathematical Modeling for Universities Teaching Supervision: Apparel Design Profession

**Wenxia Shan**

*School of Art Design, Jiangsu University of Technology,  
Changzhou 213001, Jiangsu, China*

### Abstract

In order to review the effect on the art teaching supervision aided by computer, the comprehensive evaluation on the art teaching supervision and research results of the art teaching supervisor is required in the university. A full range system for art teaching supervision performance assessment that is a novel quantized method is researched in this paper. Furthermore, the comprehensive evaluation processing and evaluation model are accomplished. The application results for art teaching supervision performance review assessment which is developed as a computer management system demonstrated its high operability and achieved accurate can be convenient for the same requirements.

Key words: TEACHING SUPERVISION, VALUE-ASSESSMENT MODEL, COMPREHENSIVE EVALUATION, QUANTITATIVE CRITERIA

### 1. Introduction

The higher education has been made worldwide achievements which supported a strong talent and intellectual for our innovative country built in the P.R. China. In order to make further efforts and sustainable competitive advantage for popularization of higher education, the universities teaching supervision was supported to undergraduate a teacher which is suggested by the Supervision of the Education Ordinance of the No.624 Decree of the State Council of the People's Republic of China in 2012. Universities teaching supervision is an important part of universities teaching quality monitoring and security system through supervision, inspection, assessment, guidance, etc., on the teaching practice round, the whole process, multi-level monitoring, and it plays an

irreplaceable role in teaching management, teaching style and construction of study style building.

With the construction of the Internet + and wisdom campus, university supervisors and charged with a new mission, but also put forward more and higher requirements. Many researchers focus on the teaching methods and assessment model or architecture on universities course. Mir Sun provided by cloud-based services when cooperating in a mobile environment, being organized into cloud-based teaching strategies namely "Jigsaw Classroom", planning and publishing tasks, as well as rationalizing task allocation and mutual supervision [1]. Meshkova described a novel laboratory and project course called Small, Embedded, Advanced and Generic Objects Laboratory [2]. Svane, T. supported a new

models for teaching and assessment in edutainment software design [3]. Verleger, M. described the all-campus and engineering training programs at Purdue University [4]. Onan, A. performed an evaluations regarding the monitoring, assessing and managing of the teaching process in Hacettepe University [5]. Butgereit, L. presented a model for provided a virtual "flipped classroom" between Sudan and South Africa [6]. Anna Löfmark explored the lived experience of supervising mentors in Sweden during the practice-based, off-campus sections of the education in teaching, nursing, and social care [7]. Alison Evans supported a framework for supervision of MBI teachers [8]. Irene WY Ma described how to evaluate the teaching and supervision of junior residents in central venous catheterization (CVC) by resident-teachers [9]. Situational analysis of teaching and learning of medicine and nursing students at Makerere University was reported by Sarah Kiguli etc. [10]. Faculty evaluation must be approached more analytically, objectively, and comprehensively to ensure that all nursing educators receive the fairest treatment possible and that the teaching-learning process is enhanced [11]. Field notes from workshop discussions and participant evaluations were used to gain insight into participant confidence in cross cultural supervision [12]. Ayoub Kafyulilo studied factors affecting of teachers' continuation [13]. Pansy Chung insist integrating practical talents with practical industrial experiences and competences can help avoid discrepancy and close the gap between vocational education and the practical demands of industries [14]. Thu Ngo etc., proposes additional refinements, particularly to the system of attitude, informed by research into the deployment of evaluative resources in spoken discourse by postgraduate students in small group discussions in English and in Vietnamese [15]. Desmond Mene Lee Hang and Beverley Bell discussed the use of written formative assessment as a scaffold for teacher development for formative assessment [16]. Luísa Mariele Strauss and Denis Borenstein presented the construction and application of a system dynamics model for analyzing long-term policies concerning undergraduate programs in Brazil at an aggregate level [17]. Elena Nardi analyzed how to identify appropriate mathematics education literature [18]. Hui-Hua Pai etc., suggests that further investigation into features of effective unstructured small-group tasks might yield heuristics that teachers could eventually use to make decisions about when collaboration would be most useful [19].

Almost all of reference can be considered at the model built. However, there are more nondeterministic, nonfigurative in the assessment criteria, but less quantitative, detailed, exact signs in the assessment criteria.

Ten aspects from various angles to evaluate the art supervisor which include course chosen selected to art teaching evaluation for supervisor himself, Day-to-Day teaching management evaluation for supervisor himself, art teaching construction evaluation, professional qualifications, supervisor position evaluation, supervisor art education background, supervisor oversea working background, achievements of art teaching and research, awards and honors evaluation, and other works evaluation respectively. In order to get objectively an evaluation results comparable, the relative quantitative evaluation followed the criteria that performance assessment should be more use of quantitative indicators.

## 2. Quantization and comprehensive methods for evaluating indicator

### 2.1. Quantification of qualitative factors

The "excellent", "good", "medium", "general", "unqualified" (Represented by A, B, C, D, and E respectively) are used to represent for the quantitatively difficultly describe factors as multiple grade standard. Quantitative estimation by scoring, etc. is given which is based on the qualitative analysis. So the results have mathematical statistical properties.

For example, the evaluation of the teaching approach can be used to express satisfaction. Assume there isn't individual evaluation factors of the teaching attitude for a teacher, and  $x$  individual estimation is "excellent" or "good", then define the degree of satisfaction is  $x/n$ . It can also use the scores to indicate such as quantize A, B, C, D, and E to the scores of 90, 80, 70, 60, and 0 respectively. Consider there are  $n$  individual estimations, and the results with A, B, C, D, and E are  $x_1, x_2, x_3, x_4$  and  $x_5$  respectively. That is  $n = x_1 + x_2 + x_3 + x_4 + x_5$ . Let  $E = (x_1, x_2, x_3, x_4, x_5)$  and  $Q = (90, 80, 70, 60, 0)$ , Then the score is  $(E \times Q^T)/n$ , and it can be used in the application systems.

### 2.2. Quantification of quantitative factors

A linear sum of weighted is used to make the comprehensive assessment, that is,

$$Y = \sum W_i \times R_i. \quad (1)$$

Here,  $Y$  is the value of comprehensive assessment  $W_i$  is  $i$  - th evaluating indicator, and  $R_i$  is  $i$  - th weight coefficient.

## 3. Evaluation model and methods

### 3.1. Evaluation methods and calculation models

In order to comprehend and maintenance convenient, we use the vector to represent the evaluation factors, evaluation results, and the weight coefficients, and it can be run calculation fast.

1) Teaching evaluation for supervisor himself

The first evaluation factors is teaching evaluation vector, which is defined as  $\mathbf{M}_1 = (m_1, m_2, \dots, m_5)$ , here  $m_1$  to  $m_5$  be represented the results given by student assessment, assessment of teachers listening, assessment of colleagues, assessment of department heads, and assessment of other supervisors respectively. The teaching evaluation coefficients vector is defined as  $\mathbf{R}_1 = (r_1, r_2, \dots, r_5)$ , here  $r_1$  to  $r_5$  be represented the weight coefficients for the each factors above respectively. It reflects the significance grade for each other. That is,

$$\mathbf{S}_1 = \mathbf{M}_1 \times \mathbf{R}_1^T. \quad (2)$$

Let  $\mathbf{Q}_1 = (90, 80, 70, 60, 0)$ ,  $\mathbf{M}_{11} = (m_{10}, m_{11}, \dots, m_{19})$ ,  $\mathbf{R}_{11} = (r_{10}, r_{11}, \dots, r_{19})$ .

Here,  $m_{10}$  to  $m_{19}$  represented the observance by teaching regulations for lectures; freshness for lectures, good work attitude, preciseness style; clear thinking, concept accurate; adept courses to be taught, give prominence to key areas; integrate theory with practice; attention to inspire and guide students to actively thinking; interact frequently between teacher and students, lively classroom atmosphere; rational and effective use of teaching methods; correct homework earnestly; the overall evaluation score for teachers respectively.  $r_{10}$  to  $r_{19}$  are the weight coefficients for the 10 aspects of the student assessments.

Assume there are  $n$  assessments of the students, for the  $m_{1i}$  - th ( $i = 0, 1, \dots, 9$ ) assessment, the assessment results of A, B, C, D, and E are  $x_{ai}$ ,  $x_{bi}$ ,  $x_{ci}$ ,  $x_{di}$  and  $x_{ei}$  respectively. Let  $\mathbf{E}_{1i} = (x_{ai}, x_{bi}, x_{ci}, x_{di}, x_{ei})$ , then

$$x_{ai} + x_{bi} + x_{ci} + x_{di} + x_{ei} = n, \quad (3)$$

$$m_{1i} = (\mathbf{E}_{1i} \times \mathbf{Q}_1^T) / n, \quad (4)$$

$$m_1 = \mathbf{M}_{11} \times \mathbf{R}_{11}^T. \quad (5)$$

As the same way,  $m_2$  to  $m_5$  can be calculated, and we can get the  $\mathbf{M}_1$ , the teaching evaluation scores  $\mathbf{S}_1$  can be calculated at the end. It must be explained that the various weight coefficients vector can be setup depend on the requirement.

2) Day-to-day teaching management for supervisor himself

The second evaluation factors is day-to-day teaching management evaluation vector,

which is defined as  $\mathbf{M}_2 = (m_1, m_2, \dots, m_7)$ , here  $m_1$  to  $m_7$  are represented the results given by attitude of the course teaching, the quality and progressing of tasks accomplished, the situation of attend the actions (which include the actions of art teaching and research section, department art course actions), art teaching workload, the quality and progressing of the accomplished for the teaching documentations respectively.

Evaluation vector is defined as  $\mathbf{R}_2 = (r_1, r_2, \dots, r_7)$ , here  $r_1$  to  $r_7$  are represented the weight coefficients of seven evaluating indicator listed above respectively. It reflects the significance grade for each other.

Day-to-Day teaching management evaluation scores:

$$\mathbf{S}_2 = \mathbf{M}_2 \times \mathbf{R}_2^T. \quad (6)$$

The grade of attend the actions and art course teaching should be depend on the assessment regulations. Assume there are  $n$  assessments for the supervisor as a teacher, for the  $m_{2i}$  - th ( $i = 0, 1, \dots, 7$ ), the assessment results of A, B, C, D, and E are  $x_{ai}$ ,  $x_{bi}$ ,  $x_{ci}$ ,  $x_{di}$  and  $x_{ei}$  respectively. Let  $\mathbf{E}_{1i} = (x_{ai}, x_{bi}, x_{ci}, x_{di}, x_{ei})$ , then

$$x_{ai} + x_{bi} + x_{ci} + x_{di} + x_{ei} = n, \quad (7)$$

$m_{1i} = (\mathbf{E}_{1i} \times \mathbf{Q}_1^T) / n$ .  $m_1$  to  $m_5$  can be calculated respectively, and we can get the  $\mathbf{M}_2$ , the Day-to-Day teaching management evaluation scores  $\mathbf{S}_2$  can be calculated at last. The various weight coefficients vector can be setup depend on the requirement too.

3) Art curriculum teaching construction

Art curriculum teaching construction evaluation vector is defined as  $\mathbf{M}_3 = (m_1, m_2, m_3, m_4)$ , here  $m_1$  to  $m_4$  are represented the distinction that the supervisor as a teacher was involved in major art curriculum construction, CAI, micro-courseware, MOOC, FlippedClass Model or course Web-sit development, workshops of art curriculum construction, and teaching material editing or organizing respectively. Evaluation weight vector  $\mathbf{E}_3 = (e_1, e_2, e_3, e_4)$ , here  $e_1$  to  $e_4$  are represented the rank coefficients of four evaluating indicator listed above respectively.

$$\mathbf{D}_3 = \mathbf{M}_3 \cdot \mathbf{E}_3 \quad (8)$$

$\cdot$  is the multiplication dot of two vectors.

Evaluation vector is defined as  $\mathbf{R}_3 = (r_1, r_2, r_3, r_4)$ , here  $r_1$  to  $r_4$  are represented the weight coefficients of four evaluating. It reflects the significance level for each other. Art curriculum teaching construction evaluation scores:

$$\mathbf{S}_3 = \mathbf{D}_3 \times \mathbf{R}_3^T. \quad (9)$$

The major construction, CAI, micro-

courseware, MOOC, FlippedClass Model or course Web-sit development, and workshop of art curriculum construction have four grade which are national, provincial, university, and department level respectively. But the grade segmentation is not need to detailed, such as the major construction does not distinguish between brands and features. The level of national, provincial, university, and department are remarked A, B, C, and D grade, and quantized 90, 80, 70, and 60 scores respectively, and let  $Q_3 = (90, 80, 70, 60)$ . Personal ranks represented by rank coefficients vector. For example, consider  $W_3 = (1, 0.7, 0.5, 0.3, 0.1)$ , here 1, 0.7, 0.5, 0.3, 0.1 represented the first range, the second range, and so on. Under the fifth range is the same weight 0.1.

#### 4) Professional qualifications

Professional qualifications evaluation vector is defined as  $M_4 = (m_1, m_2, m_3, m_4)$ , here  $m_1$  to  $m_4$  be represented the importance level on the specialty research and teaching contribution level scheme. The professional qualifications level is represented common renowned artist, professor, artist and associate professor respectively.  $G_4 = (g_1, g_2, g_3, g_4)$ , here  $g_1$  to  $g_4$  are represented the rank weight of the professional qualifications grade respectively.

$$D_4 = M_4 \cdot \times G_4 \quad (10)$$

$\cdot \times$  is the multiplication dot of two vectors.

Evaluation vector  $R_4 = (r_1, r_2, r_3, r_4)$ , here  $r_1$  to  $r_4$  are represented the weight coefficients of four evaluating factors. Professional qualifications evaluation scores:

$$S_4 = D_4 \times R_4^T \quad (11)$$

#### 5) Supervisor position

Supervisor position vector is defined as  $M_5 = (m_1, m_2, m_3)$ , here  $m_1$  to  $m_3$  are represented the organization position level of art management that is international organization or national organization, university organization, and department organization respectively.  $G_5 = (g_1, g_2, g_3)$ , here  $g_1$  to  $g_3$  are represented the rank weight of the professional management organization grade respectively.

$$D_5 = M_5 \cdot \times G_5 \quad (12)$$

$\cdot \times$  is the multiplication dot of two vectors.

Evaluation vector defined by  $R_5 = (r_1, r_2, r_3)$ , here  $r_1$  to  $r_3$  are represented the weight coefficients of three evaluating factors. Supervisor organization position level scores:

$$S_5 = D_5 \times R_5^T \quad (13)$$

If a supervisor own more then one art management organization list above, then the highest influence vector will be opted.

#### 6) Supervisor art education background

Supervisor art education background vector is defined as  $M_6 = (m_1, m_2, m_3)$ , here  $m_1$  to  $m_3$  be represented the importance level of art education background that is PhD, MS, and BS respectively. The education level of PhD, MS, and BS are remarked A, B, and C grade, and quantized 95, 80, and 65 respectively, and let  $G_6 = (95, 80, 65)$ .

$$D_6 = M_6 \cdot \times G_6 \quad (14)$$

$\cdot \times$  is the multiplication dot of two vectors.

Evaluation vector defined by  $R_6 = (r_1, r_2, r_3)$ , here  $r_1$  to  $r_3$  be represented the weight coefficients of three evaluating factors which can depend on the different university. It reflects the significance level for each other. Supervisor art education level scores:

$$S_6 = D_6 \times R_6^T \quad (15)$$

If a supervisor own more then one degree list above, then the highest degree vector will be opted.

#### 7) Supervisor oversea working background

Supervisor oversea working background vector is defined as  $M_7 = (m_1, m_2, m_3, m_4)$ , here  $m_1$  to  $m_4$  be represented the time lengths has been oversea. The oversea working background level of more then 5 years, more then 4 years, more then 2 years, and more then 1 year are remarked A, B, C, and D grade, and quantized 95, 85, 75, and 65 respectively, and let  $G_7 = (95, 85, 75, 65)$ .

$$D_7 = M_7 \cdot \times G_7 \quad (16)$$

$\cdot \times$  is the multiplication dot of two vectors.

Evaluation vector defined by  $R_7 = (r_1, r_2, r_3, r_4)$ , here  $r_1$  to  $r_4$  be represented the weight coefficients of four evaluating factors depend on the different country. It reflects the significance level for each other.

Supervisor oversea working background scores is,

$$S_7 = D_7 \times R_7^T \quad (17)$$

#### 8) Achievements of art teaching and research

Achievements of art teaching and research  $S_8$  depends on the computational method of the university, calculate the workload of research and teaching first, then determine the grade from A, B, C, or D compared with the basic requirements workload for each positions of teaching and art researches. The grade of A, B, C, and D are quantized to 100, 85, 75, and 60 scores. Let  $Q_8 = (100, 85, 75, 60)$ , and  $S_8$  is one of  $Q_8$ .

#### 9) Awards and honors

Awards and honors evaluation vector is defined as  $M_9 = (m_1, m_2)$ , here  $m_1$  and  $m_2$  are represented the level of rewards and honors respectively. The levels of awards and honors

compose of international, national, provincial, university, and department respectively. Each level does not been divided any sub-level. For example, the provincial level does not been divided as every department of province. The levels of national, provincial, university, and department are remarked A, B, C, D, E and F, and quantized to 100, 90, 80, 70, 60 and 50 scores respectively, and let  $Q_9 = (100, 90, 80, 70, 60, 50)$ , value  $m_1$  is selected from  $Q_9$ .

Personal ranks represented by rank coefficients vector. For example, consider  $W_9 = (1, 0.7, 0.5, 0.3, 0.1)$ , here 1, 0.7, 0.5, 0.3, 0.2 and 0.1 represented the first range, the second range, and so on. Under the sixth range is the same weight 0.1, value  $m_2$  is selected from  $W_9$ . Awards and honors evaluation scores is,

$$S_9 = \sum m_1 \times m_2. \quad (18)$$

10) Other works

Other works scores  $S_{10}$  is been given directly by the assessment group depended on art teaching work situation of the teachers.

### 3.2. Weights distribution

The supervisor's art working highlights and orientation will be influenced directly by the each weights of the evaluation indicators system, and the dissuasion of the evaluation results will be directly affected. So given a certain weight of art and reasonable evaluation factors accorded to the importance is very important. There are several ways to determine the weights of evaluation factors, such as the AHP (Analytic Hierarchy Process), PCA (Principal Component Analysis), FA (Factor Analysis), etc.

### 3.3. Evaluation models

Let  $S = (S_1, S_2, \dots, S_{10})$ , and weights of art teaching evaluation for supervisor himself, Day-to-Day teaching management evaluation for supervisor himself, art teaching construction evaluation, professional qualifications, supervisor position evaluation, supervisor art education background, supervisor oversea working background, achievements of art teaching and research, awards and honors evaluation, and other works evaluation are  $W_1$  to  $W_{10}$  respectively, consider the  $W = (W_1, W_2, \dots, W_{10})$ .

Then, the total evaluation scores for the supervisor given by

$$Q = W \times W^T. \quad (19)$$

According to the grades and the times on infraction discipline, the grades and the times of the absenteeism and the teaching mistakes or lack of supervision, and then use this equation to calculate the total scores, finally, the art supervision assessment grade can be determined.

## 4. Conclusions

The art supervision assessment is a complex and complicated task, the multi-factor and multi-view comprehensive evaluation method which quantized the nondeterministic evaluation indicators to the quantitative results are researched in this papers. It is not only advantageous the statistical analysis, but also reduce the qualitative evaluation of instability and errors. As time changes, a variety of evaluation factors could be changed, so we should focus on the times and let it refresh the art supervision actual situation. In order to improve working efficiency, given the evaluation results quickly and objectively, we should to have the aid of modern information technologies, collected the evaluation data online, and using the art supervision evaluation system to accomplish the assessment process.

The art supervision assessment has used in our department after the comments have collected extensively by computer networks. Evaluation results have been achieved the objectivity and credibility. Our interesting work will focus on the factor analysis, how to determine the weights of the evaluation indicators, and the optimization research on the calculation models.

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### References

1. Geng Sun, Jun Shen (2014) Facilitating Social Collaboration in Mobile Cloud-Based Learning: A Teamwork as a Service (TaaS) Approach. *IEEE Transactions on Learning Technologies*, 7(3), p.p.207 - 220
2. Meshkova, E., Riihijarvi, J., Mahonen, P. (2008) Teaching embedded systems with active learning: The SMEAGOL approach. *Proc. Conf. on 38th Annual Frontiers in Education*, Saratoga Springs, NY, America, p.p.F1H-18 - F1H-23
3. Svane, T., Aderklou, C., Fritzdorf, L., Hamilton-Jones, J. (2001) Knowledge by user demand and self-reflection: new models for teaching and assessment in edutainment software design. *Proc. Conf. on 31th Annual Frontiers in Education*, Reno, NV, America, p.p.TIB - 1-6
4. Verleger, M., Velasquez, J. (2007) An engineering teaching assistant orientation program: Guidelines, reactions, and lessons learned from a one day intensive training program. *Proc. Conf. on 37th Annual Frontiers in Education - Global Engineering: Knowledge Without Borders*,

- Opportunities Without Passports*, Milwaukee, WI, America, p.p.S4G-3 - S4G-7
5. Onan, A., Turan, S., Gürten, E. (2014) Do moodle reports and logs meet the needs of educational supervision?. *Proc. Conf. on 9th Iberian Conference on Information Systems and Technologies*. Barcelona, Spain, p.p.1- 5
  6. Butgereit, L., Osman, I. (2014) Using a “flipped classroom” in an online PhD programme. *Proc. Conf. on IST-Africa*. Le Meridien Ile Maurice, Maurice, p.p.1– 7
  7. Anna Löfmark, Åsa Morberg, Lennart S. Öhlund. Julian Illicki (2009) Spervising mentors’ lived experience on supervision in teaching, nursing and social care education. A participation-oriented phenomenological study. *Higher Education*, 57 (9135), p.p.107–123
  8. Alison Evans, Rebecca Crane, Lucinda Cooper, Jody Mardula, Jenny Wilks (2014) A Framework for Supervision for Mindfulness-Based Teachers: a Space for Embodied Mutual Inquiry. *Mindfulness*. 6(292), p.p.572-581
  9. Irene WY Ma, Elise Teteris, James M Roberts, Maria Bacchus. (2011) Who is teaching and supervising our junior residents’ central venous catheterizations? *BMC Medical Education*, 11(16), p.p.1-4
  10. Sarah Kiguli, Rhona Baingana, Ligia Paina (2011) Situational analysis of teaching and learning of medicine and nursing students at Makerere University College of Health Sciences. *BMC International Health and Human Rights*, 11(S3), p.p.1-9
  11. Mahvash Salsali (2005) Evaluating teaching effectiveness in nursing education: An Iranian perspective. *BMC Medical Education*, 5(29), p.p.1-9
  12. Penelope Abbott, Jennifer Reath, Elaine Gordon, Darshana Dave (2014) General Practitioner Supervisor assessment and teaching of Registrars consulting with Aboriginal patients – is cultural competence adequately considered? *BMC Medical Education*, 14(167), p.p.1–8
  13. Ayoub Kafyulilo, Petra Fisser, Joke Voogt (2015) Factors affecting teachers’ continuation of technology use in teaching. *Education and Information Technologies*, 2015(9398), p.p.1–20
  14. Pansy Chung, Ron Chuen Yeh, Yi-Cheng Chen (2015) Influence of problem-based learning strategy on enhancing student’s industrial oriented competences learned: an action research on learning weblog analysis. *International Journal of Technology and Design Education*. 2015(9306), p.p.1–23
  15. Thu Ngo, Len Unsworth (2015) Reworking the appraisal framework in ESL research: refining attitude resources. *Functional Linguistics*, 2(1), p.p.1–24
  16. Desmond Mene Lee Hang, Beverley Bell (2015) Written formative assessment and silence in the classroom. *Cultural Studies of Science Education*. 2015(9600), p.p.1-13
  17. Luísa Mariele Strauss, Denis Borenstein (2015) A system dynamics model for long-term planning of the undergraduate education in Brazil. *Higher Education*. 69(9781), p.p.375-397
  18. Elena Nardi (2015) “Not Like a Big Gap, Something We Could Handle”: Facilitating Shifts in Paradigm in the Supervision of Mathematics Graduates upon Entry into Mathematics Education. *International Journal of Research in Undergraduate Mathematics Education*, 1(2), p.p.135-156
  19. Hui-Hua Pai, David A. Sears, Yukiko Maeda (2015) Effects of Small-Group Learning on Transfer: a Meta-Analysis. *Educational Psychology Review*, 27(9260), p.p.79-102

