Evaluating teaching performance in elementary schools based on multi-criterion decision making

A D Yasa¹,*, D D Chrisyarani¹, D M Utama² and R K Werdiningtiyas¹

¹Elementary School Teacher Education Study Program, Universitas Kanjuruhan Malang, Jl. S. Supriadi No. 48 Malang, 65148, Indonesia
²Department of Industrial Engineering, University of Muhammadiyah Malang, Jl. Raya Tlogomas 246 Malang, 65144, Indonesia

*arnelia@unikama.ac.id

Abstract. Teaching performance evaluation is an important factor to improve the quality of teaching as well as the quality of school management. This paper aimed to evaluate teaching performance in elementary schools. Since Information and Communication Technology (ICT) support is one of the multi criteria of evaluation, AHP and SAW integration was suggested to evaluate teaching performance. In the evaluation process, AHP method was used to consider criteria and sub-criteria. Therefore, a case study was conducted to describe the issue. The results showed that both the methods of AHP and SAW were objective, accurate, and scientific in evaluating elementary school teachers’ teaching performance. It is expected that the tool is used to be able to improve teaching performance in elementary schools.

1. Introduction

The first paragraph Competitiveness is one of the important aspects in education. One of the aspects to enhance schools’ competitiveness is teaching because good teaching will be influential to the quality of education [1]. In other words, the improvement of education quality is influenced by teaching performance [2]. It is well-known that quality teaching is one of the primary objectives of education. Therefore, schools are in need of evaluating their teachers’ teaching performance [3]. Evaluating teaching performance aims to measure the effectiveness of teaching and learning system [4]. In addition, performance evaluation is also proven to improve the teachers’ performance [2]. Schools will be able to identify the quality of teaching through evaluation of teaching performance. Therefore, a scientific and effective method is necessary in measuring the teaching performance.

Several studies in relation to teaching performance evaluation have been conducted. Yang et al proposed a method namely Analytical Hierarchy Process (AHP) to evaluate teaching quality [5]. Dong & Dai developed a model evaluating teaching performance using a fuzzy neural network model [6]. Those two studies share the same idea that ICT is such a good support in evaluating teaching performance. In line with this, Oddershede, Donoso, Farias, and Jarufe utilized the support of ICT in evaluating teaching performance as well. They implemented the AHP method to measure teaching criteria comprehensively [7]. Moreover, Chen et al evaluated teaching performance using fuzzy AHP method and proved that the method was scientific, accurate, and objective [3].

In addition to the AHP method, evaluating teaching performance can also be conducted using another method. Nemec, Baker, Zhang, & Dintzner designed an evaluating method called Student
Evaluation of Teaching (SET) which was proven to be effective in evaluating teaching performance [8,9]. Another method was developed by Kettler et al. who evaluated teaching performance using Multiple-Methods (MMs) [10].

There are differences between the current study and the previous ones. In this study, the subjects are elementary school teachers. The ICT-supported evaluation was carried out in three different schools. The method used to evaluate teaching performance is AHP. Meanwhile, decision making method is used to determine the evaluation criteria [11]. There are a variety of decision making method such as AHP, SAW, TOPSIS, and PROMETHEE. However, this study uses AHP and SAW for decision making since they easy to use. Based on the aforementioned reasons, this study aims to evaluate teachers' teaching performance in elementary schools.

2. Research methodology

2.1. The proposed teaching performance evaluation framework

This study proposed three stages of teaching performance evaluation (see figure 1).

![Figure 1. The teachers teaching performance evaluation framework proposed.](image)

2.1.1. Phase 1: Determining criteria. One of the important points in the beginning of evaluation is determining the evaluation criteria. In this phase, we built a team to select the criteria and sub-criteria of evaluation. The team studied literature to finally decide the criteria and sub-criteria of teaching performance evaluation.

2.1.2. Phase 2: Analytical hierarchy process. The Analytical Hierarchy Process was proposed by [12]. The first step of AHP technique was making a comparative matrix of several pairs of criteria and sub-criteria (Matrix A). The pairwise comparison was based on a nine-level scale measurement. Scale (1) shows that both criteria are equally important, scale (3) shows that one of the criteria is a little bit more important, scale (5) shows that one of the criteria is more important, scale (7) shows that one of the criteria is clearly more important, and scale (9) shows that one of the criteria is absolutely more important. The pairwise comparison is to normalize and acquire the value for matrix A. The
normalization is done by dividing the value of the columns with the number of columns. This principle, which is that of Eigen vector can be seen in equation 3. Finally, the last step in pairwise technique is calculating consistency (see equations 4 and 5). The value of sub-criteria is based on the multiplication of criteria and their sub-criteria.

\[
A = \begin{bmatrix}
    a_{11} & a_{12} & \cdots & a_{1n} \\
    a_{21} & a_{22} & \cdots & a_{2n} \\
    \vdots & \vdots & \ddots & \vdots \\
    a_{n1} & a_{n2} & \cdots & a_{nn} 
\end{bmatrix} \quad (1)
\]

\[
a_{ij} \neq 0, \quad a_{ii} = 1, \quad a_{ji} = \frac{1}{a_{ij}} \quad (2)
\]

\[
AW = \lambda_{\text{max}}W \quad (3)
\]

\[
CI = \frac{\lambda_{\text{max}} - n}{n - 1} \quad (4)
\]

\[
CR = \frac{CI}{RI} \quad (5)
\]

2.1.3. Phase 3: Evaluating teaching performance using SAW method. Teachers’ teaching performance was evaluated using simple additive weighting (SAW) method. To do so, the method required criteria and sub-criteria and their values. Criteria and sub-criteria valuing was done using AHP. In general, there are five steps of SAW [13]. The first step is to create ranks among the teaching evaluated through the criteria and sub-criteria using the 1-5 ranking scale. 1 for very dissatisfied, 2 for dissatisfied, 3 for satisfied enough, 4 for satisfied and 5 for very satisfied. The second step is making decision making matrix $X$ (see equation 6), which is formulated from the ranking table of the teachers’ match upon the criteria and sub-criteria available. The value of $X$ of each teacher ($A_i$) on each sub-criterion is determined, where and the third step is normalizing the decision making matrix by calculating the values of normalized performance of the alternative on sub-criteria (see equation 7). The fourth step is formulating normalization matrix ($R$) based on the value of $rij$ (see equation 8). The fifth step is adding the multiplication of normalized matrix ($R$) with the value of sub-criteria (see equation 9). The biggest value reflects the best teaching performance.

\[
x = \begin{bmatrix}
    X_{i1}X_{12} & \cdots & X_{i1}X_{1j} \\
    X_{i2}X_{22} & \cdots & X_{i2}X_{2j} \\
    \vdots & \vdots & \vdots \\
    X_{in}X_{n2} & \cdots & X_{in}X_{nj} 
\end{bmatrix} \quad (6)
\]

\[
rij = \begin{cases} 
    \frac{x_{ij}}{\text{Max} x_{ij}} & \text{if } j \text{ is benefit attribute} \\
    \frac{\text{Min} x_{ij}}{x_{ij}} & \text{if } j \text{ is cost attribute}
\end{cases} \quad (7)
\]

\[
R = \begin{bmatrix}
    r_{11} & \cdots & r_{1j} \\
    \vdots & \ddots & \vdots \\
    r_{n1} & \cdots & r_{nj} 
\end{bmatrix} \quad (8)
\]

\[
V_i = \sum_{j=1}^{n} w_j r_{ij} \quad (9)
\]
2.2. Research procedure
In this study, we did the evaluation of teaching performance at three elementary schools. The evaluation focused on teaching performance at the fourth grade. Each school had two teachers to evaluate so that the total number of teachers performing as respondents in this study was 6. In the meantime, the evaluation team consisted of two experienced teachers and two educational experts. The team conducted a series of focus group discussion (FGD). Some of the sessions aimed at (1) selecting the criteria and sub-criteria; (2) determining the level of importance of each criterion and sub-criterion; and (3) determining the teacher evaluation based on sub-criteria. The criteria and sub-criteria were set based on previous studies. The level of importance of the criteria and sub-criteria used the 1-9 scale assessment. The assessment of teachers’ teaching performance used a 1-5 Likert scale.

3. Result and discussion
The results of FGD by the evaluation team showed that there are seven criteria used in evaluating teachers’ teaching performance. Of the seven criteria, there are nineteen sub-criteria used. The seven criteria are planning and preparation (PP), communication and interaction (CI), teaching for learning (TL), the ICT system used (ICT), managing the learning environment (ME), student evaluation (SE), and professionalism (P) (see Table 1).

| Criteria                        | Sub-criteria                                               | Reference |
|---------------------------------|------------------------------------------------------------|-----------|
| Planning and preparation (PP)   | Clarity of learning objectives (PP1)                       | [3]       |
|                                 | Selection of Learning material (PP2)                      | [14]      |
|                                 | Details of learning scenarios (PP3)                       | [14]      |
| Communication and interaction (CI)| Ability to explain in detail and depth (CI1)          | [3]       |
|                                 | Writing skills (CI2)                                     | [3]       |
|                                 | Skills for managing varied questions, and relevant (CI3)  | [15]      |
| Teaching for learning (TL)      | 3.1 Motivate students in learning (TL1)                   | [16]      |
|                                 | Use of a student centre based approach (TL2)             | [16]      |
|                                 | Use of innovative methods, models and strategies (TL3)    | [14]      |
| ICT System (ICT)                | 4.1 Office Software (ICT1)                               | [7]       |
|                                 | Video Teaching (ICT2)                                    | [7]       |
|                                 | Internet (ICT3)                                          | [7]       |
| Managing the learning environment (ME) | Ability to manage classes (ME1)                        | [16]      |
|                                 | Skills guiding group discussion (ME2)                    | [16]      |
| Student evaluation (SE)         | Provide evaluation of learning to students (SE1)         | [17]      |
|                                 | Provide feedback (SE2)                                   | [17]      |
| Professionalism (P)             | Self-development to increase professionalism (P1)       | [18]      |
|                                 | Evaluate learning (P2)                                   | [18]      |
|                                 | Responsive to school policies (P3)                        | [18]      |

The FGD results of the evaluation team on the criteria and sub-criteria level of importance show that planning and preparation (PP) has the biggest values as shown in figure 2, and ICT is on the third place of the criteria level of importance. This result is in line with the result of a study by Chen, et al. which proved that PP is an important thing to carry out by teachers [3]. Teachers are able to design learning materials and scenario through planning and preparation [19].
Figure 2. Criterion weighting result.

Figure 3. Weighting sub-criterion result.

The results of sub-criteria valuing (figure 3) show that the clarity of learning objective (PP1) has the highest value. Moreover, students’ learning motivation (TL1) has the second highest value, followed by Internet (ICT3) in the third place. Learning outcome is one of the most important aspects in teaching and learning since clear learning objectives describe students’ learning outcomes [20]. Furthermore, motivation is also an important sub-criterion since their learning outcomes are influenced by learning motivation [21]. Therefore, teachers play an important role in motivating their students to learning. Internet is also an important part of evaluating teaching performance. Nowadays, students have learning motivation through internet since both students and teachers acquire a lot of learning information from it [7]. The results of the teaching performance evaluation (figure 4) show that teacher 3 has the highest score of teaching performance. The position is then followed in order by teacher 4, teacher 6, teacher 2, teacher 5, and teacher 1. The analysis shows that in general, teachers’ teaching performance is optimal due to their attention to the criteria of good teaching.

Figure 4. The results of teaching performance evaluation.
4. Conclusion
The main purpose of the study was to evaluate teachers’ teaching performance. The results of the
study used 7 criteria and 19 sub-criteria of teaching performance evaluation. To do so, this study
implemented AHP and SAW methods. It has been proven that both methods were objective, accurate,
and scientific to evaluate elementary school teachers’ teaching performance. Future research is
expected to add more complex criteria of teaching performance evaluation.

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