Workload self-evaluation base on expert system for vocational teacher

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Abstract. This research aims to create a design related to workload of vocational school teachers in which the teachers can make evaluation on their implementation task burden in doing their teacher work as vocational school teachers. A workload will affect on work quality so that it is necessary for an appropriate and optimal measurement. This design uses NASA TLX analysis measurement method to measure workload on mental demand, physical demand, temporal demand, performance, effort and frustration level. Implementation of calculation on this workload uses software with artificial intelligence system technique namely Fuzzy logic method with Tsukamoto technique. Input of the data on this workload measurement is conducted by a teacher and its results can be seen about its workload.

1. Introduction

Teacher competence is greatly required in developing learners' ability, particularly its role in education quality improvement. For vocational education teacher as learning agent, it is required to have ability to implement learning process correctly in the framework of National development. in order to make good teaching process, teachers should have good competence. Quality or competence of Vocational School teachers can be seen from four aspects, namely pedagogic competence (understanding on learners, curriculum, learning designing, learning implementation, use of learning technology, evaluation of learning results and education vision); personal competence (faithful and believe in God, wise, democratic, having spirit of being role model for learners and community, and having ability of self-potential development); social competence (having ability to interact politely with students and colleagues); and professional competence (teacher ability on teaching material mastery both conceptual and implementation). These four competences are obliged to be owned by professional teachers. The four competencies can be explained by professional teacher work in Regulation of workload regulated in the Law Number 14 of the year 2005 concerning Teachers and University Teachers article 35 paragraph (2) stating that workload of teacher teaching is at least 24 hours and at most is 40 hours per week, in fact achieve Workload of a teacher in relation to period of activity for a week is 56.02 hours [1]. It is also necessary to consider any neglected workload in its calculation as workload as certified (professional) vocational teachers in a more specific design, namely issue of energy demands, and the demand can be seen from any activities conducted by the teachers, namely: 1) planning the learning, 2) implementing the learning (face-to-face teaching), 3) daily evaluation, 4) learning evaluation in the middle and end of semester, 5) administration tasks 6)

development of teacher competence, 7) guidance practice tasks, 8) extracurricular activity, and developing educational profession, 9) other additional tasks (additional position).

Workload is the main pressure which is found to have positive correlation with emotional exhaustion among many jobs including teachers [2]. Pressure placed on workload of teacher shall make their moral lower, decrease effectiveness, lead to high absenteeism, and lower degree of professionalism [3]. In regard to the reality, the excessive workload will be influencing an individual performance. Great workload place on workers may reduce their performance quality.

1.1. Factors affecting workload:

- Time pressure: Time pressure is often placed on vocational teachers to accomplish material in accordance with specified syllabus. Likewise, the accumulation of grades, as a result of evaluation, has short time constraint resulting in, sometimes, errors in great quantities.
- Working hour or schedule: Working hours set for teachers in performing their duties in the school are, sometimes, not suffice, requiring in home completion of their works.
- Role ambiguity and role conflict: Role ambiguity and role conflict have effects on teacher perception of her workload. This is either threat or challenge.
- Noise: Noise has effect on workers' health and performance. Those workers having activities under noisy conditions may be influenced in their effectiveness to accomplish their duties and, thus, their concentration and accomplishment are disrupted, making their workload heavier.
- Information overload: Information accepted and absorbed by workers in great quantities simultaneously makes workload heavier. The complexity of technologies and the use of very sophisticated work facilities require individual adaptation of workers. More complex information accepted, where each of them has different consequences, has effect on the worker learning process and secondary effect on the health if it is not put in proper management.
- Repetitive action: Jobs in great quantities requiring repetitive bodily action, such as repetitive instruction of practices as students have different capacities for understanding, or repetitive administrative jobs anytime may create boredom, monotonous and, in turn, emotional pressure. Pleonastic activities have effects on the parasympathetic nervous system and decline in performance due to increase in the workload [4].
- Ergonomic aspect of work layout: To keep workers are in normal work area, the work layout will have to create proper, reasonable anatomic position, not enough by optimizing it. Workers moving back and forth in everyday activity, have a job in unbalanced bodily position (too much in squat or stand position) or working equipment in unsuitable position (very high or very low) and so on may influence their limb, such as tense muscle, exhaustion, etc. This is affecting indirectly an individual perception of workload to be settled. Mental workload and responsibility in an activity is fair construction to understand and predict performance in complex activity system [5].
- Responsibility: Each type of responsibility is workload for some of people. Different types of responsibilities have different functions of pressure. Accurate workload measurement on an individual is an important element of determination of the individual to maintain efficiency and safety on the job [6].

1.2. Workload measurement

- Workload may be measured based on work hour other than using objective measurement based on energy-based workload. Energy is power to take an action or work (effort). Energy is one of fundamental measures based on caloric requirement and excretion. A teacher activity may be measured based on her caloric excretion.
- The number of workload on vocational teacher may be measured by using appropriate methods. In general, the workload may be measured in three ways [7]:

1.2.1. Measurement Method NASA-TLX: NASA-TLX is a method used to analyze workload faced by any workers that have to conduct various activities in their works. NASA-TLX is a measurement technique to predict certain individual performance in doing their work tasks [8]. This measurement is based on six factors, namely Mental demand (MD), Physical demand (PD), Temporal demand (TD), Performance (P), Effort(E), Frustration level (FR). Data collection and analysis by using NASA-TLX technique is conducted based on inputs and processed ranging from weighting of six dimensions in pairs, provision of rating, calculating product values for 6 indicators (MD, PD, TD, CE, FR, and EF) namely:

Produk = rating x bobot faktor   (1)

Calculating Weighted Workload WWL,
WWL = ∑ Product   (2)

and then it is conducted score interpretation

1.2.2. Expert System. An expert system is one of the strongest branches of Artificial Intelligence [9], Expert system can extract additional information from users by giving some questions relate to any problems faced during consultation. Role and superiority of this expert system are in the interaction with users and its ability to provide explanation and conclusion of any issues in a limited and directed manner.

1.2.3. Design system. This design uses Tsukamoto method of fuzzy inference system based on reasoning concept. An expert system consists of a knowledge base and an inference engine [9] In the reasoning method, crisp values in consequence area can be obtained directly based on calculation through the fuzzy set. Figure 1 below is fuzzy set as parameter to map workload level in score of workload category.
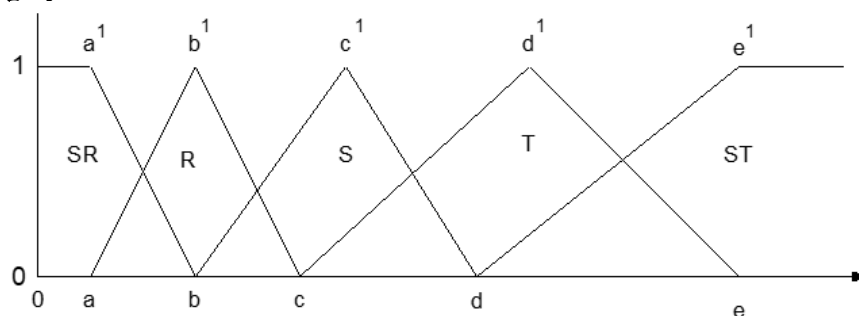

Figure 1. Design input.

One of the formula to obtain sub set of,

$$\mu_{SR}(x) = \begin{cases} 1 & ; \ x \leq a^1 \\ \dfrac{b-x}{b-a^1} & ; \ a^1 \leq x \leq b \\ 0 & ; \ x \geq b \end{cases} \qquad (3)$$

Through the expert system, the system can extract additional information from users by giving a number of questions related to any problems faced during consultation, so that it can show any reasons related to the problems.
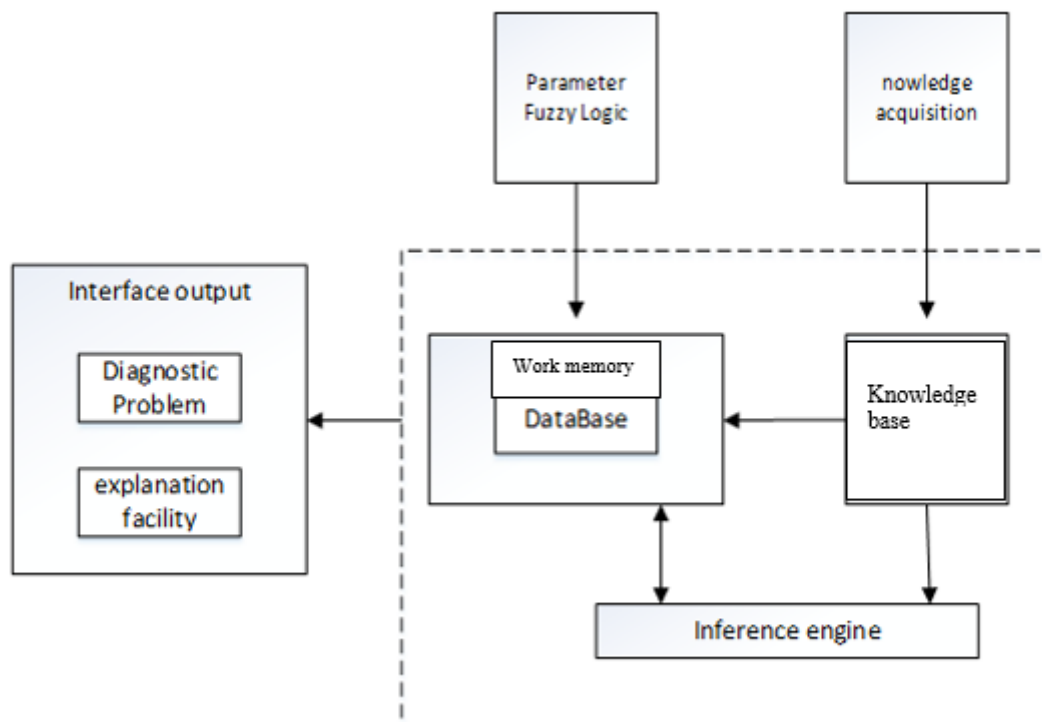
Figure 2. Architecture of expert system to measure teacher workload.

Existing facts will be acquired; source of data serves as documentation to be processed and organized in a structured manner so that there will be an ability to process the data into efficient solutions. After data acquisition process, then the data is represented as a knowledge base as clear rules that is coding to match any acquired facts systematically. Then, inference engine will conduct the reasoning by using the content of list of rules to test the rules one by one until the rule conditions are correct, this is inseparable by using facility of database. Interface output will determine fuzzy group and will inform workload condition of vocational teacher as well as any expected solutions. This is result of diagnose on the system.

Meanwhile, it is necessary to consider any required time load by measuring conformity level between time and mental load, in this case by seeing at workload in term of mental load pressure mainly in preparing learning materials, the way in facing students in the class by making optimal learning pattern so that the whole students can optimally understand the subjects in each meeting; so, each stage given to reach the final ends can be achieved namely learners with expected competencies. Teacher work in making learning evaluation and value provision system can be quite an important indicator since there are any obstacles for teacher mental in determining objective value; the obstacles relate to final ends and examination during learning process.

2. Conclusion
the outputs generated from the measurement by using NASA-TLX method and expert system method to implement this measurement system are in the forms of workload level from very light until weighty workload level so that teachers can know their work ability whether it is over or less so that it can directly provide accurate solution for the follow-up.

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