A Study on Performance Assessment Methods by Using Fuzzy Membership Function and Fuzzy Reasoning

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Abstract - Performance assessment was introduced to improvement of self-directed learning and method of assessment for differenced learning as the seventh educational curriculum is enforced. Performance assessment is overcoming limitation about problem solving ability and higher thinking abilities assessment that is problem of a written examination and get into the spotlight by way for quality of class and school normalization. But, performance assessment has problems about possibilities of assessment fault by appraisal, fairness, reliability, and validity of grading, ambiguity of grading standard, difficulty about objectivity security etc.

This study proposes fuzzy performance assessment system to solve problem of the conventional performance assessment. This paper presented an objective and reliable performance assessment method through fuzzy reasoning, design fuzzy membership function and define fuzzy rule analyzing factor that influence in each sacred ground of performance assessment to account principle subject. Also, performance assessment item divides by formation estimation and subject estimation and designed membership function in proposed performance assessment method. Performance assessment result that is worked through fuzzy performance assessment system can pare down burden about appraisal's fault and provide fair and reliable assessment result through grading that have correct standard and consistency to students

I. INTRODUCTIONS

The seventh educational curriculum was purposed in upbringing that is the self-regulating and creative Korean to lead 21st century globalization info-age. It is educational curriculum that is "Quality administration style educational curriculum" based on estimation for improvement of level education and own leading teachability. This country is still backward in education that is used mainly written examination to emphasize in objectivity, trustability, efficiency. But, it was focused on the cognitive evaluation that is simple and measurement. It is difficult to evaluate about learner's problem solving ability and higher thinking ability. Also, there is shortcoming that is focused in evaluation of simple knowledge memorization.

Performance Assessment is emphasized again recently by method to supplement this shortcoming. There are many methods in performance assessment. Appraiser observes not only examination but also processing of learners' studying achievement and observes result directly and evaluates the result. That is, performance assessment will be understood by "Estimation which consist by teacher of various way through various data at process of class" and may have to be encouraged.

It is general approaching method that is evaluated the properties of cognitive, definitive and heart. There is advantage that could learner's various thinking ability by open estimation method. But, performance assessment has problems about possibilities of assessment. It is appraisal fault, fairness, reliability, validity of grading, ambiguity of grading standard, and difficulty about objectivity security etc.

This study proposes fuzzy performance assessment system to solve problem of the conventional performance assessment in subject of accounting. This paper presented an objective and reliable performance assessment method through fuzzy reasoning. It designed fuzzy membership function and defined fuzzy rule analyzing factor that influence in each sacred ground of performance assessment. Also, performance assessment item divides by formation estimation and subject estimation and designed membership function in proposed performance assessment method.

II. PERFORMANCE ASSESSMENT

Performance assessment is introduced by variety of estimation and part of clear estimation guarantee that is included in 'Education vision 2002, new school culture creation' plan. It is estimation method to see process or result that teacher achieves student's studying assignment and estimates especially about student's info, function and attitude.

Performance assessment has the characteristics outlined below [6].

- Not that a student selects right answer in problems, it is evaluation system to make out right answer own or do so that may appear by action.
- Estimated achieving the object of education in actuality situation. That is not just to select right answer under abstract situation. It is estimated observing education processing directly in actuality situation.
- Focused on not only result of teacher/learning but also processing of teacher/learning.

- Emphasize that consist continuously and is whole to grasp each student's changing / developmental stages
- Regard not only estimating student's changing / developmental stages but also driving cooperation group.
- Diagnosed student's studying and taking effort to promote individuation learning.
- General approaching method that is evaluated the properties of cognitive, definitive and heart.

It is process central estimation method that a student can drive problem solving spontaneously. And it grasps student's synthetic ability to be correct and there is propriety.
It is useful estimation in point that offers relevant estimation result that aid in class improvement to a student and teacher. But, It has a problem that hasty school introduction is much caused without well-thought out examination and rumination about actuality application possibility.

Specially, it is important objectivity and fairness about result of performance assessment. But it made to lose authoritativeness about marking being realized that is connected directly with report to a student who be appraised. There is improvement way about these problems. These ways are such as valuation basis choice that is atomized through teachers' subject negotiation, opening of valuation basis, colleague estimation, self-appraisal are consisting. But it is remained problems of estimation that is objectivity, believability, and propriety.

III. PROPOSED ALGORITHM

Performance assessment was enforced with introduction of the 7th educational curriculum. It can derive own studying who is learner's experience. And it is important in terms of can estimate process during studying whole. Kimchoongho studied "research about operation in middle school's performance assessment". He said problems of performance assessment. There are large scale enforcement difficulty, failure of estimation, and error of estimation. Performance assessment was good at introduction of the 7th educational curriculum. But, performance assessment has problems about possibilities of assessment fault by appraisal, fairness, reliability, and validity of grading, ambiguity of grading standard, difficulty about objectivity security etc.

Fuzzy theory has several methods. It marking way that is subjective and consistency is been lacking of teacher factors that influence to achievement subject consider. And it makes that teacher may can evaluate easy being depersonalized about marking standard. It makes that students can be effective about result of performance assessment.
In this paper, we proposed fuzzy performance assessment system to solve problem using fuzzy membership function and fuzzy reasoning in web application. It considered factor that influence in each field about performance assessment of high school's accounting principle subject. It solved problems that are difficult appraiser's consistency interested person, fairness of marking, believability, propriety improved problem, objectivity problem etc. And it do that can estimate points by subjective judgment of teacher object-

tively. We applied in account principle subject among various achievement estimation area. And we solved problem for existent marking error portion using suitable formation estimation and assignment estimation (a report).
We defined reflection ratio about account principle subject that written examination is 60% and performance assessment is 40%. Reflection ratio can be changed going through subject negotiation to each subject. And we defined formation estimation about each performance assessment area that distribution of marks ratio is 30% and assignment estimation (a report) is 10%.

A. Designed membership function through formation estimation consider degree of difficulty

We deigned membership function through formation estimation analysis about the right answer rate, consider degree of difficulty. Number of formation estimation's problem is 10. And it is considered degree of difficulty at formation estimation. It is degree of difficulty that consider but how many students set right answer about some problem. Therefore, degree of difficulty is between values 0 to 1. In this paper, we divided degree of difficulty that is high, middle, low. We defined high, middle, and low among formation estimation's degree of difficulty.
Because of degree of difficulty, we divided by good(G), middle(M), and bad(B) when evaluate about problem that a student guesses right answer. We set the variable x that is number of problem to guess right answer particularly about each degree of difficulty. The membership function is figure 1.
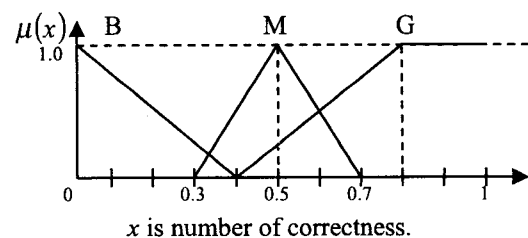

x is number of correctness.

Fig. 1. The membership function about formation estimation that considered degree of difficulty

Reasoning rule of performance assessment system is created by expert's knowledge or experience. Rule is reasoned by IF ~ THEN form. It can use expert's experience and knowledge in natural language. We classified by A, B, C, D, and E level by membership function that fuzzy rule applied degree of difficulty about formation estimation.
We design systems that are reasoning rule. And it is available some control by application example or expert.
We examined formation estimation to students. We classified A, B, C, D, and E level by fuzzy rule according to degree of difficulty particularly. And it was designed membership function that converts from level to point. It is figure 2.
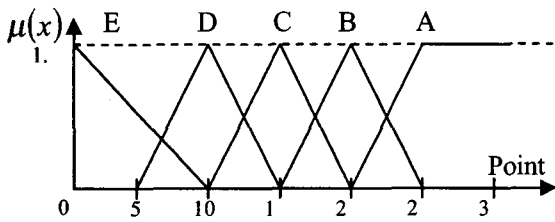
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Fig. 2. The membership function about point

Formation estimation does by 30 points full marks. We calculated point by defuzzification. It appeared by quantitative numerical value about 5 level that is precarious and is language. In this paper, in Equation 1, we applied central value by defuzzification. It expressed quantitative point.

$$X' = \frac{\int \mu_i(x)x\,dx}{\int \mu_i(x)\,dx} \tag{1}$$

B. Designed membership function about assignment estimation (Report)

In assignment estimation (Report), teacher presents subject. Then, students make out and submit a report because collect, analyze and synthesize data about the subject.

In this paper, students have to submit after end of a section of subject of account principle. We evaluated report that is based in 3 standards. As coincide in each standard, teacher evaluates via 10 points. We considered 3 standards of levels that is quality of subject and subject of report.

It was decided by teacher voluntarily. We set the 10% about estimation of report that is among distribution of marks ratio 40% of whole assignment estimation. When student submit report, teacher makes 3 standard. And it was evaluated whether coincide how in the standard. It was marked point by 10 points full marks.

We defined applied 3 standard that is F1, F2, F3. These standards were considered special quality and taking a serious view degree of subject. It was decided by teacher voluntarily. When teacher evaluated report, the result was by teacher's management. Therefore, we applied membership function about point. It was designed the systems that can prevent estimation error about estimation. It could heighten propriety degree and believability about estimation.

We examined report to students. We classified good (G), middle (M), and bad (B) levels by 3 standard. Appraiser teacher evaluated point by 10 points full marks. Figure 3 is membership function about evaluation of report.
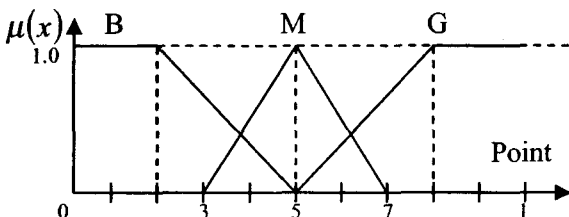

Fig. 3. The membership function about levels by 3 standards

We examined report to students. We classified good (G), middle (M), and bad (B) levels by 3 standard. We classified A, B, C, and D by fuzzy rule according to degree of difficulty particularly. And figure 4 is designed membership function that converts from level to point.

We set the 10% about estimation of report that is among distribution of marks ratio 40% of whole achievement estimation. The highest point is 10 point about point of report is 10 points and the lowest point is 5 points
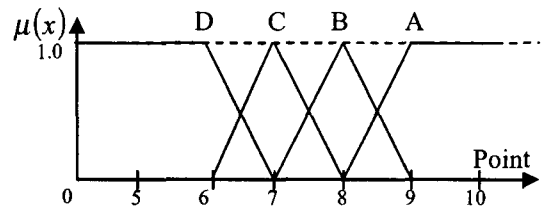

Fig. 4. The membership function about point by 4 levels

In this paper, proposed defuzzification is used most usually. And it took advantage of central value fuzzy to calculate quantitative point. Flowchart of assignment estimation system is figure. 5 using membership function and fuzzy reasoning.
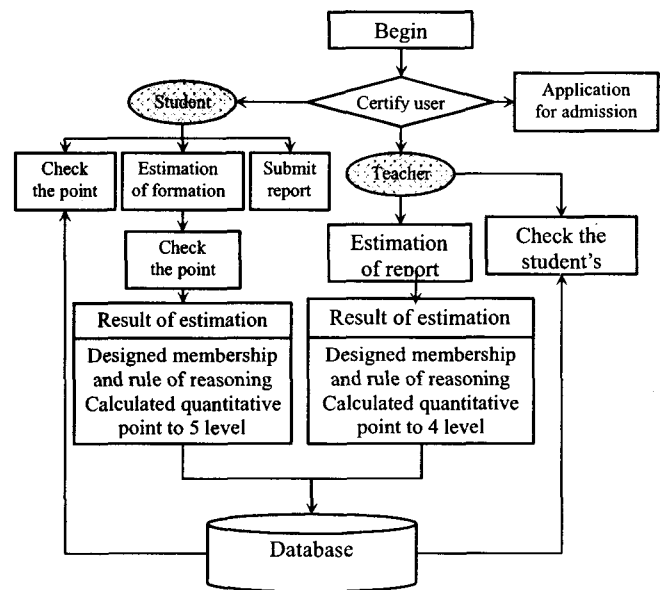

Fig. 5. Flowchart of assignment estimation system

IV. EXPERIMENTS

In this paper, the proposed assignment estimation system estimated subject of accounting principle considering degree of difficulty. It created rule using fuzzy membership function and fuzzy reasoning about formation estimation and subject estimation. It classified level lastly and minimized appraiser's error. It could heighten fairness and believability, propriety degree of marking.

It was embodied by ASP and VB Script in IBM PC that is Intel Pentium-IV 700MHz CPU and 130 MB RAM.

It Is consisted of login, subscriber of membership, official

announcement, subject of account principle, and notice board. A student does subscriber of membership and logs in. Student approach to subject that is formation estimation in subject of account principle. Then, he can solve problem and check own correctness/incorrectness. He submits report to teacher directly. He can check the learner's subject estimation and formation estimation point in individuation learner point. A student checks correctness/incorrectness after formation estimation and stores the result. System calculated problem degree of difficulty about a student.

It applied membership function using rule of reasoning and defuzzification. And it calculated final point. System analyzed degree of difficulty about number 1. If degree of difficulty is decided as high, calculated lower point than middle or low. Even if seem number of problem that students set among formation estimation 10 problems, point is marked as is different because consider degree of difficulty. Even if seem point about correcting among 10 problems, it is different because was considered degree of difficulty.
Teacher logs in by admin. He applied 3 standards about report that students had submitted. Teacher could check the students' formation estimation point. He can check the formation estimation and subject estimation according to student's name at once. Figure 6 displayed that teacher checked formation estimation and subject estimation(report) about a student and final point.

Proposed assignment estimation system considered degree of difficulty in the formation estimation. It calculated quantitative point after calculated membership value using fuzzy reasoning and rule of fuzzy. It considered degree of difficulty in the subject estimation too.

Fig. 6. Displayed that teacher checked formation estimation and subject estimation(report) about a student and final point

V. CONCLUSION

Performance assessment was introduced to improvement of self-directed learning and method of assessment for differenced learning as the seventh educational curriculum is enforced. Performance assessment is overcoming limitation about problem solving ability and higher thinking abilities assessment that is problem of a written examination and get into the spotlight by way for quality of class and school normalization. But, performance assessment has problems abo -ut possibilities of assessment fault by appraisal, fairness, reliability, and validity of grading, ambiguity of grading

standard, difficulty about objectivity security etc.

This study proposes fuzzy performance assessment system to solve problem of the conventional performance assessment. This paper presented an objective and reliable performance assessment method through fuzzy reasoning, design fuzzy membership function and define fuzzy rule analyzing factor that influence in each sacred ground of performance assessment to account principle subject. Also, performance assessment item divides by formation estimation and subject estimation and designed membership function in proposed performance assessment method.

We analyzed each problem's degree of difficulty about Formation estimation and subject estimation which is item of performance assessment. It was designed membership function by degree of difficulty. And it was defined fuzzy rule that have IF~THEN form. It calculated level of formation estimation to Max-Min reasoning.

It was calculated quantificative point by membership value. And It was calculated level of classed formation estimation using rule of reasoning. Performance assessment result that is worked through fuzzy performance assessment system can pare down burden about appraisal's fault and provide fair and reliable assessment result through grading that have correct standard and consistency to students.

REFERENCES

[1] T. J. Sung, Essence and merits and demerits of achievement estimation, Problem and diagnosis and solution way in our country, *Iwa Univ paper*, 1999.
[2] Guide of achievement estimation, *Education human resources wealth*, 1998
[3] H. J. Lee, Research Execution check/estimation in 7th educational curriculum, *Korea Institute of Curriculum & Evaluation*, 2000.
[4] C. H. Kim, research about operation in middle school's performance assessment, *Dankook Univ, Dept. of Education master's thesis*, 2000.
[5] Problem and improvement direction, *The Ministry of Edcation* ,1999.
[6] Theory and truth, *Korea Institute of Evaluation*, 1996.
[7] Jurgen Paetz, A note on core region of membership functions, *Fachbereich Biologie und informatick, Insutitut Furr Informatik, Robert-Mayer-strabe*, pp.11-15, 2002.
[8] S. K. Oh, Fuzzy model & Control systems by C Programming, *published by Naeha*, 1999.
[9] http://www.autocontrol.co.kr/magazine/9903/108-111.htm
[10] http://infornet.korea.ac.kr/data/data1/Fuzzy/fuzzy.ppt
[11] http://ceaspub.eas.asu.edu/PowerZone/FuzzyLogic/chapter%206/chapter6.html
[12] http://med-edu.hallym.ac.kr/activities/2000/freshfacuulty/item.html
[13] http://8733.netian.com/naramal/na-13.htm