Decision Support System Framework With K-Means Algorithm For Faculty Performance Evaluation Rating

Ricardo Q. Camungao

Abstract— This paper addressed the tasks of the development of the Decision Support System Framework with K-means Algorithm for Clustering Performance Evaluation Rating for the Human Resource Office of the Isabela State University – Echague Campus. The integration of the Weka 3-6 as a tool in displaying the virtual output of the clustered objects and K-means algorithm as clusterer for data interpretation of each criteria of the NBC 461 evaluation instrument plays a vital role in providing integrity of the faculty rating. The clustered result will serve as basis of the Human Resource Office for designing retooling program for faculty in the form of training’s and seminars. The researcher believed that with the Decision Support system Framework with K-means Algorithm would be big help for the Human Resource Office in designing intervention programs for faculty development and enhancements. Also, provide logic flow for system development in the near future.

Index Terms— Clustering, Data Interpretation, Decision Support Systems, Intervention Programs, K-means Algorithm, Evaluation Rating, Performance.

1 INTRODUCTION
THE Isabela State University is one of the leading State Universities and Colleges in the Philippines. Providing quality education to students is one of its primary goals, to make this noble objective possible faculty were subject for evaluation in terms of its teaching effectiveness once every semester. The NBC 461 evaluation instrument [1] is divided into four sections namely (1) Commitment, (2) Knowledge of the subject matter, (3) Teaching for independent learning and (4) Management of learning. The average of the computed mean of the four (4) sections would be the faculty evaluation rating submitted in the Human Resource Office. The application of clustering techniques in clustering the faculty performance evaluation rating using K-means Algorithm will provide integrity and importance on the performance evaluation result that specifically aims to cluster faculty into performing and non-performing, Identify the strength and weaknesses of the faculty in the four sections of the NBC 461 evaluation instrument and provide aide to top management in designing intervention programs for faculty development and enhancements every end of the academic year. The Decision Support System Framework for Clustering Performance Evaluation Rating would be a big help for the top management to ensure the teaching effectiveness of the faculty and to sustain the quality of education provided by the Isabela State University to its clienteles – the students.

2 METHODOLOGY
2.1 Academic Decision Support System
The academic decision – support system consists of four (4) phase’s namely academic decision, implementation, measurement and evaluation that work like chain one leading to the other [2] as presented in Fig 1.

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Based on the present process, treatment on the faculty rating were observed to be insignificant in enhancing the teaching effectiveness of the faculty it is in the fact that, the value of the faculty rating is not much given attention in identifying the needs of the faculty members to improve in terms of their teaching effectiveness. This scenario does not give much impact to the faculty and open doors for enhancement and improvement hence, treat the evaluation procedure as part of the activity conducted per semester for compliance purposes only.

2.3 Weka and K-means Algorithm

The Weka is a data mining software used to classify and identify the similarities and dissimilarities of objects of a given dataset. It includes variety of tools for transforming dataset for classification [3] and clustering like k-means algorithm [8]. Screenshots of the virtual environment of Weka is presented in Fig.3.

The k-means algorithm is one of the most efficient and effective partitioning techniques that provides implementations of learning algorithms that can easily apply to dataset. This algorithm is unsupervised that usually used in data mining and pattern recognition in which minimizing cluster performance index, square-error and error criterion are foundations of this algorithm [4][5]. The k-means algorithm is depicted below [8].

\[
D = \sqrt{\sum_{i=1}^{n} (x_i - z_i)^2}
\]

Eq. (1)

2.4 The Dataset

The faculty members were evaluated according to the
assessment criteria of National Budget Circular (NBC) 461 Qualitative Contribution Evaluation (QCE) form for Student Evaluation and rated using the scale of 5 being the highest and 1 is the lowest [1] [7]. There were 651 faculty members from the ten (10) campuses of the Isabela State University that were evaluated. Table 1 shows the summary of the faculty performance evaluation rating by the students for the School Year 2018 – 2019. Rating from each criterion is carried out and converted into its .arff file ready for data interpretation of the Weka software using the K-means algorithm.

### TABLE 1
SUMMARY OF THE FACULTY RATING OF SY 2018 - 2019

<table>
<thead>
<tr>
<th>NO</th>
<th>CAMPUS</th>
<th>COLLEGE</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>RATING</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Tagay</td>
<td>4.56</td>
<td>4.38</td>
<td>4.64</td>
<td>4.61</td>
<td>4.61</td>
<td>4.64</td>
<td>4.61</td>
</tr>
<tr>
<td>2</td>
<td>Catigan</td>
<td>4.63</td>
<td>4.36</td>
<td>4.64</td>
<td>4.72</td>
<td>4.46</td>
<td>4.65</td>
<td>4.56</td>
</tr>
<tr>
<td>3</td>
<td>Cauayan</td>
<td>4.72</td>
<td>4.64</td>
<td>4.58</td>
<td>4.65</td>
<td>4.64</td>
<td>4.65</td>
<td>4.72</td>
</tr>
<tr>
<td>4</td>
<td>Catigan</td>
<td>4.59</td>
<td>4.56</td>
<td>4.60</td>
<td>4.79</td>
<td>4.80</td>
<td>4.65</td>
<td>4.65</td>
</tr>
<tr>
<td>5</td>
<td>Catigan</td>
<td>4.84</td>
<td>4.92</td>
<td>4.88</td>
<td>4.88</td>
<td>4.84</td>
<td>4.92</td>
<td>4.84</td>
</tr>
<tr>
<td>6</td>
<td>Cauayan</td>
<td>4.51</td>
<td>4.72</td>
<td>4.65</td>
<td>4.65</td>
<td>4.15</td>
<td>4.65</td>
<td>4.65</td>
</tr>
<tr>
<td>7</td>
<td>Echague</td>
<td>4.50</td>
<td>4.30</td>
<td>4.00</td>
<td>4.00</td>
<td>4.20</td>
<td>4.32</td>
<td>4.12</td>
</tr>
</tbody>
</table>

Legend (A) Commitment, (B) Knowledge of the Subject Matter, (C) Teaching for Independent Learning, (D) Management of Learning and (E) Critical Factors.

The Weka software was run in personal computer with an Intel core i5 2.7 Ghz CPU, 4 GB RAM and 500GB hard disk with 200 GB free disk space. The .arff file containing the rating in each criterion was simultaneously clustered using the K-means algorithm.

### 3 DECISION SUPPORT SYSTEM FRAMEWORK FOR FACULTY PERFORMANCE RATING

The result of integrating Weka and K-means algorithms in clustering the dataset presented in section 2.4 was shown in Table 2. As a result, number of performing and non - performing faculty members were identified in every criteria of the NBC 461. Each criterion consists of rating in two semesters that represents the performance of the faculty in one academic year. There were 173, 260, 372, 132 and 249 non – performing faculty members under the Commitment, Knowledge of the Subject Matter, Teaching for Independent Learning, Management of Learning and Critical Factors respectively identified that need attention of the Human Resource Management Office for faculty retooling.

### TABLE 2
SUMMARY OF CLUSTERED FACULTY RATING

<table>
<thead>
<tr>
<th>Assessment Area</th>
<th>Higher/Performing</th>
<th>Cluster Centres</th>
<th>Number of Objects</th>
<th>Lower/Underperforming</th>
<th>Cluster Centres</th>
<th>Number of Objects</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Commitment</td>
<td>4.64, 4.24</td>
<td>477</td>
<td>14.12, 14.12</td>
<td>173</td>
<td>132</td>
<td>260</td>
</tr>
<tr>
<td>B. Knowledge of the Subject Matter</td>
<td>4.41, 4.76</td>
<td>382</td>
<td>14.12, 14.12</td>
<td>200</td>
<td>100</td>
<td>120</td>
</tr>
<tr>
<td>C. Teaching for Independent Learning</td>
<td>4.30, 4.44</td>
<td>378</td>
<td>14.40, 14.48</td>
<td>300</td>
<td>150</td>
<td>150</td>
</tr>
<tr>
<td>D. Management of Learning</td>
<td>4.2, 4.32</td>
<td>515</td>
<td>4.08, 4.12</td>
<td>132</td>
<td>65</td>
<td>65</td>
</tr>
<tr>
<td>E. Critical Factors</td>
<td>4.62, 4.51</td>
<td>401</td>
<td>4.28, 4.23</td>
<td>200</td>
<td>100</td>
<td>100</td>
</tr>
</tbody>
</table>

4 CONCLUSIONS

This paper presented the Decision Support System Framework with K-means algorithm through integrating Weka tools in the present system shown in Fig 4. Result of testing the framework was presented in Table 2, the identified number of performing and non – performing faculty members in every criteria of the NBC 461 will be use as basis of the Human Resource Management Office to plan and identify intervention programs for faculty enhancements and retooling. With this, the proponent learned that the framework developed provide an avenue for enhancing faculty competencies and in sustaining the quality education that the students deserved. In line with this, it is strongly recommended for the design and development of the program interface of the framework.

REFERENCES


