Application and research of fuzzy clustering analysis algorithm under “micro-lecture” English teaching mode

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ABSTRACT: The fuzzy clustering algorithm is to classify the data or indicators with a greater degree of similarity based on the principle of the same type of individuals possessing a greater similarity, and different types of individuals possessing differences, establish clear category boundaries, form any shape of relationship clusters in the solving process, and input the research indicators at random, in order to accurately analyze the significance of the indicators in the algorithm. The evaluation value of the clustering analysis can be obtained by the establishment of the fuzzy factor set based on the membership analysis, and the evaluation result can be analyzed through reference to the evaluation indicators of the fuzzy clustering analysis. The “micro-lecture” English teaching mode can be estimated and the analysis indicators can be rationally established based on the fuzzy clustering analysis algorithm, with better algorithm applicability.

Keywords: micro-lecture; fuzzy clustering; teaching mode; flipped learning

1 INTRODUCTION

“Micro-lecture” is a new teaching mode. For the understanding of “micro-lecture”, it mainly has the following viewpoints. Some scholars believe that the “micro-lecture” mode is a basic course, which serves for blended learning, flipped learning and a variety of learning styles; Hu Tiesheng and other scholars believe that “micro-lecture” teaching can be viewed as a kind of network video course, and become a part of teaching design; Jiao Jianli and other scholars believe that, as a kind of English teaching resource, the online education is subject to dapper online video, and aims at realizing the course scenario, digitization and interest. Based on the above analysis, the “micro-lecture” English teaching is based on the video as the main teaching medium. Each micro lecture is a complete teaching based on a knowledge point or a concept. “Micro-lecture” video can be from the network resources, and can also be produced or recorded by the English teachers. It is mainly subject to the platform of network, so that the students can implement free leaning through mobile devices. Of course, the micro-lecture video can be added in the ordinary classroom teaching, in order to improve the teaching quality.

2 FUZZY CLUSTERING ANALYSIS UNDER “MICRO-LECTURE” ENGLISH TEACHING MODE

The main form of micro-lecture applied in college English teaching based on the establishment of the factor set is \(U_1\); the scope of content selection of college English micro-lecture is \(U_2\); the development strategy of micro-lecture in college English teaching is \(U_3\); the characteristic of micro-lecture in college English teaching is \(U_4\); the path analysis of micro-lecture and college English teaching is \(U_5\):

\[
U = (U_1, U_2, U_3, U_4, U_5)
\]

The fuzzy clustering analysis indicators are established according to five main factor sets, as shown in Table 1.

3 FUZZY CLUSTERING ANALYSIS ALGORITHM UNDER “MICRO-LECTURE” ENGLISH TEACHING MODE

(1) To determine the factor domain in the process of modeling:
Table 1. Fuzzy clustering analysis indicators

<table>
<thead>
<tr>
<th>Main form of micro-lecture applied in college English teaching $U_1$</th>
<th>Scope of content selection of college English micro-lecture $U_2$</th>
<th>Development strategy of micro-lecture in college English teaching $U_3$</th>
<th>Characteristic of micro-lecture in college English teaching $U_4$</th>
<th>Path analysis of micro-lecture and college English teaching $U_5$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Micro-lecture teaching in general English classroom $u_{11}$</td>
<td>Phonological knowledge $u_{21}$</td>
<td>Integration and convergence of micro-lecture and traditional English classroom teaching $u_{31}$</td>
<td>Enhancement of students interest in English learning $u_{41}$</td>
<td>English micro-lecture resources $u_{51}$</td>
</tr>
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<td>Students independent learning environment outside the classroom $u_{12}$</td>
<td>Syntax, semantic knowledge $u_{22}$</td>
<td>Professional business level of English teachers $u_{32}$</td>
<td>Freedom and flexible learning time of micro-lecture $u_{42}$</td>
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<td>Listening and speaking practices or “English corner” and other related practical activities $u_{13}$</td>
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<td>Dapper micro-lecture $u_{43}$</td>
<td>Introduction of supporting policies and encouragement of the teachers and students to make micro-lecture $u_{53}$</td>
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<td>English micro-lecture skills $u_{34}$</td>
<td>Facilities, platforms and resources applied in micro-lecture $u_{34}$</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Non-language knowledge $u_{25}$</td>
<td></td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

$U = \{u_1, u_2, \cdots, u_n\}$

(2) To determine the evaluation domain:

$V = \{v_1, v_2, \cdots, v_n\}$

(3) To determine the fuzzy evaluation matrix

$R = (r_{ij})_{n \times m}$:

$R = \begin{bmatrix}
    r_{11} & r_{12} & \cdots & r_{1m} \\
    r_{21} & r_{22} & \cdots & r_{2m} \\
    \vdots & \vdots & \ddots & \vdots \\
    r_{n1} & r_{n2} & \cdots & r_{nm}
\end{bmatrix}$

The evaluation $f(u_i)(i=1,2,\cdots,n)$ can be made for each factor $u_i$, so as to obtain a fuzzy mapping $f$ from the factor domain $U$ to the evaluation domain $V$, namely:

$f : U \rightarrow F(U)$

$u_i \mapsto f(u_i) = (r_{i1}, r_{i2}, \cdots, r_{im}) \in F(V)$

Then, to find out the fuzzy relation $R \subseteq F(U \times V)$ from the fuzzy mapping $f$, namely:

$R_f(u_i, v_j) = f(u_i)(v_j) = r_{ij} (i = 1, 2, \cdots, n; j = 1, 2, \cdots, m)$

(4) To establish a weight set, $A=(a_1, a_2, \cdots, a_n) \in F(U)$, boundary conditions:

$\sum_{i=1}^{n} a_i = 1 \quad a_i \geq 0$

$B = A \cdot R$

$= \begin{bmatrix}
    r_{11} & r_{12} & \cdots & r_{1m} \\
    r_{21} & r_{22} & \cdots & r_{2m} \\
    \vdots & \vdots & \ddots & \vdots \\
    r_{n1} & r_{n2} & \cdots & r_{nm}
\end{bmatrix} \cdot \begin{bmatrix}
    a_1 \\
    a_2 \\
    \vdots \\
    a_n
\end{bmatrix}$

$= \begin{bmatrix}
    b_1 \\
    b_2 \\
    \vdots \\
    b_n
\end{bmatrix}$

(5) To evaluate the fuzzy clustering

For the weight $A=(a_1, a_2, \cdots, a_n) \in F(U)$, the model $M(\wedge, \vee)$ can be used for maximum - minimum compositional operation, thus obtaining comprehensive evaluation:

$B = A \circ R$ (\Leftrightarrow b_j = \sqrt[n]{a_i \wedge r_{ij}}, j = 1, 2, \cdots, m)$

The determination of the weight $A=(a_1, a_2, \cdots, a_n)$ of the evaluation set $V$ is an important part in the process of modeling. The main reason is that, in the evaluation process, the determination is made through the establishment of the fuzzy relation from reality. The fuzzy comprehensive evaluation model selected in the process of modeling is $(U, V, R)$. For the weight $A=(a_1, a_2, \cdots, a_n) \in F(U)$, the fuzzy evaluation matrix is $R = (r_{ij})_{n \times m}$. The model $M(\wedge, \vee)$ can be used to obtain the comprehensive evaluation process:

$B = A \circ R = (b_1, b_2, \cdots, b_n) \in F(V)$,

where: $b_j = \sqrt[n]{a_i \wedge r_{ij}}$ (j = 1, 2, \cdots, m).
\[ b_j = \frac{1}{n} \sum_{i=1}^{n} (a_i \land r_j) \quad (j = 1, 2, \ldots, m) \]

The evaluation set can be obtained by the above fuzzy clustering algorithm.

\[ U_1 = \{u_{11}, u_{12}\} ; \]
\[ U_2 = \{u_{21}, u_{22}, u_{23}, u_{24}\} ; \]
\[ U_3 = \{u_{31}, u_{32}, u_{33}, u_{34}, u_{35}\} ; \]
\[ U_4 = \{u_{41}, u_{42}, u_{43}, u_{44}\} ; \]
\[ U_5 = \{u_{51}, u_{52}, u_{53}\} ; \]

In the process of modeling, the following five ranking matrixes can be obtained: the main form of micro-lecture applied in college English teaching \( U_1 \), the scope of content selection of college English micro-lecture \( U_2 \), the development strategy of micro-lecture in college English teaching \( U_3 \), the characteristic of micro-lecture in college English teaching \( U_4 \), the path analysis of micro-lecture and college English teaching \( U_5 \).

In this paper, the weight factor fuzzy set of a single-layer indicator is:

\[ U_1^* = \{u_{11}, u_{12}, u_{13}\} = \{0.25, 0.55, 0.2\} ; \]
\[ U_2^* = \{u_{21}, u_{22}, u_{23}, u_{24}, u_{25}\} = \{0.25, 0.55, 0.2\} ; \]
\[ U_3^* = \{u_{31}, u_{32}, u_{33}, u_{34}, u_{35}\} = \{0.54, 0.1, 0.24, 0.14\} ; \]
\[ U_4^* = \{u_{41}, u_{42}, u_{43}, u_{44}\} = \{0.24, 0.31, 0.22, 0.23\} ; \]
\[ U_5^* = \{u_{51}, u_{52}, u_{53}\} = \{0.3, 0.43, 0.27\} . \]

The weight vector obtained from the evaluation process:

\[ \beta = \{\beta_1, \beta_2, \beta_3, \beta_4, \beta_5\} = \{0.3, 0.3, 0.2, 0.1, 0.1\} \]
\[ U_i^* = U_i \cdot \beta^T \]
\[ U_1^* = 10, \quad U_2^* = 9.4, \quad U_3^* = 5.6, \quad U_4^* = 4, \quad U_5^* = 4 \]

After normalization,

\[ U_1' = 0.303, \quad U_2' = 0.285, \quad U_3' = 0.170, \quad U_4' = 0.121, \quad U_5' = 0.121 \]

Thus

\[ \overline{A} = (0.28, 0.25, 0.21, 0.13, 0.13) \]

Based on \( \overline{A} = (0.28, 0.25, 0.21, 0.13, 0.13) \), five clustering factor sets under the micro-lecture English teaching mode can be analyzed: the main form of micro-lecture applied in college English teaching, the scope of content selection of college English micro-lecture, the development strategy of micro-lecture in college English teaching, the characteristic of micro-lecture in college English teaching, proportion of path analysis of micro-lecture and college English teaching, and the corresponding weight value. The weight value and impact of the main form of micro-lecture applied in college English teaching is the maximum.

This paper establishes the evaluation membership, as shown in Table 2.

<table>
<thead>
<tr>
<th>Evaluation method</th>
<th>Score range</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>0-60</td>
</tr>
<tr>
<td>Very good</td>
<td>0</td>
</tr>
<tr>
<td>Good</td>
<td>0</td>
</tr>
<tr>
<td>General</td>
<td>0.05</td>
</tr>
<tr>
<td>Bad</td>
<td>0.95</td>
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For the establishment of secondary indicators, the process is complex. The experience-based judgment is made for the micro-lecture English teaching according to the research data and literature and cases, and the importance degree of the secondary indicators is reflected based on the size of the score. In this model, the secondary indicators are determined by reference to the domestic and foreign literatures, thus obtaining the clustering evaluation value of the micro-lecture English teaching.

The above analysis indicators can be used to obtain Table 3.

The evaluation sets of five main factors are obtained from application of micro-lecture in college English teaching:

Main form of micro-lecture applied in college English teaching:

\[ U_1 = \begin{bmatrix} 0 & 0 & 0.05 & 0.95 \end{bmatrix} \]

Scope of content selection of college English micro-lecture:

\[ U_2 = \begin{bmatrix} 0 & 0.05 & 0.9 & 0.05 \end{bmatrix} \]

Development strategy of micro-lecture in college English teaching:

\[ U_3 = \begin{bmatrix} 0 & 0 & 0.05 & 0.95 \end{bmatrix} \]

Table 3. Fuzzy clustering analysis evaluation indicators

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Table 3. Fuzzy clustering evaluation value under “micro-lecture” English teaching mode

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<th>Each indicator, Value</th>
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<td>Professional business level of English teachers $u_{22}$ General</td>
<td></td>
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</table>

English teaching:

$$U_3 = \begin{bmatrix}
0 & 0 & 0.05 & 0.95 \\
0 & 0 & 0.05 & 0.95 \\
0 & 0 & 0.05 & 0.95 \\
0 & 0.05 & 0.9 & 0.05 \\
\end{bmatrix}$$

Characteristic of micro-lecture in college English teaching:

$$U_4 = \begin{bmatrix}
0 & 0 & 0.05 & 0.95 \\
0 & 0 & 0.05 & 0.95 \\
0 & 0 & 0.05 & 0.95 \\
0 & 0.05 & 0.9 & 0.05 \\
\end{bmatrix}$$

Path analysis of micro-lecture and college English teaching:

$$U_5 = \begin{bmatrix}
0 & 0 & 0.05 & 0.95 \\
0 & 0.05 & 0.9 & 0.05 \\
0 & 0.05 & 0.9 & 0.05 \\
\end{bmatrix}$$

According to the formula

$$B_i = A_i \cdot R_i$$

The fuzzy evaluation matrix can be obtained by the normalization processing of $B_i$.

$$B = B_{12} = \begin{bmatrix}
0.07 & 0.26 & 0.14 & 0.41 \\
0 & 0.16 & 0.74 & 0.54 \\
0.14 & 0.14 & 0.31 & 0.17 \\
0.16 & 0.21 & 0.31 & 0.34 \\
0.11 & 0.32 & 0.26 & 0.31 \\
\end{bmatrix}$$

The evaluation value is obtained based on the fuzzy clustering analysis algorithm:

$$Z = U^* \cdot B = \begin{bmatrix}
0.38 & 0.33 & 0.10 & 0.19 \\
\end{bmatrix}$$

In the evaluation value $Z$, $0.38 > 0.33 > 0.1 > 0.19$. By reference to the evaluation indicators of the fuzzy clustering analysis, the maximum values in $Z$ is corresponding to the evaluation indicators of 90-100. The result shows that the “micro-lecture” obtains a better evaluation in English teaching mode, and its application prospects and improved teaching effect are also obvious.

4 CONCLUSION

With the continuous deepening of the micro-lecture education, the educational pattern can increase the students’ interest in English learning, and enhance students’ independent learning ability. This paper carries out the fuzzy clustering based on the similarity of indicators, and form any shape of relationship clusters, and input the research indicators at random, in order to accurately analyze the applicability of the micro-lecture English teaching mode.

REFERENCES

