Decision Support System in Online Training Process Management for Implementing Complex Open Ended Assignments in Engineering Education

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Problem formulation and the relevance of its solving

A great variety of decision support systems is used to make quick and reliable decisions in educational activity in general and in engineering education in particular. The systems are applied in learning path planning, educational programmes implementation, online courses developing, online training process management etc.

Existing methods of decision making are not effective in case of online training process management in implementing complex open ended assignments (COA), which cannot be checked by a test (for example, term papers, calculation and graphic works, laboratory works). The number of COA in engineering education is more than in preparation of specialists in other fields. This make the problem solving relevant for engineering education.

A method and DSS, implementing it, are suggested to overcome such challenge.
A method of decision support based on error classification with the use of intelligent technologies

The method is based on:

• classification of typical errors which are situated in error guide;
• utilization of knowledge base which implement production rules, obtained by means of online learning effectiveness cognitive map and expert methods.

Error classes:

• errors connected with knowledge, skills and abilities (KSA) in the current training course;
• errors connected with KSA in the previously undergone training courses (background errors);
• errors, which are not connected with KSA in training courses.
A method of decision support based on error classification with the use of intelligent technologies: method scheme
A method of decision support based on error classification with the use of intelligent technologies: knowledge base construction scheme

Indicators of training process:
• errors repeatability among the students;
• a number of attempts of turning a work (a stage of work) in;
• a number of errors;
• a percentage of background errors;
• a percentage of errors, which are not connected with KSA in training courses;
• the absence of errors removal in repeated execution.
A method of decision support based on error classification with the use of intelligent technologies: online learning effectiveness cognitive map.
Decision making effectiveness evaluation

The formula for calculating the integral indicator for a course:

\[ E_C = \frac{1}{q} \sum_{i=1}^{q} E_i \]  \hspace{1cm} (1)

where \( q \) – a number of stages in the course; \( E_i \) – the value of integral indicator of effectiveness of \( i \)-th stage.

The formula for calculating the integral indicator for a course stage:

\[ E = 0,243e_1 + 0,2e_2 + 0,233e_3 + 0,114e_4 + 0,086e_5 + 0,124e_6 \] \hspace{1cm} (2)

where \( e_i \) – the normalised value of the \( i \)-th indicator.
DSS implementation

- web technologies: HTML, CSS, JavaScript, Ajax, PHP;
- Tau Prolog as Prolog interpreter (JavaScript software);
- MySQL as a DBMS;
- local server Denwer for DSS implementing, testing and introducing.
DSS implementation: a screen form of typical errors classification
DSS implementation: a screen form of inference of the decisions

<table>
<thead>
<tr>
<th>Data for decision making</th>
<th>Decisions</th>
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<tbody>
<tr>
<td>Actual errors repeatability among the students, %</td>
<td>P1=2 (splitting task (subtask) implementation into two stages is NOT required)</td>
</tr>
<tr>
<td>Actual number of attempts of turning a work (a stage of work) in</td>
<td>P2=3 (current course materials correction is NOT required)</td>
</tr>
<tr>
<td>Actual number of errors</td>
<td>P3=1 (background material preparing and a step “work with background material” adding is required)</td>
</tr>
<tr>
<td>Actual percentage of background errors</td>
<td>P4=3 (correction of formal requirements for work implementation is NOT required)</td>
</tr>
<tr>
<td>Actual percentage of errors, which are not connected with KSA</td>
<td>P5=2 (correction of the recommendation on error recovery is NOT required)</td>
</tr>
<tr>
<td>Actual absence of errors removal in repeated execution</td>
<td></td>
</tr>
<tr>
<td>Availability of background material</td>
<td></td>
</tr>
<tr>
<td>Current course errors with invalid repeatability</td>
<td></td>
</tr>
<tr>
<td>Background errors with invalid repeatability</td>
<td></td>
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<tr>
<td>Errors which are not connected with KSA with invalid</td>
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DSS implementation: a screen form of solutions effectiveness evaluation
Experiment description and results

The method was utilized in online training process management during term paper performance on the subject “Design of automated system of data processing and control” in Ufa state aviation technical university.

The trends in the integral indicator at all stages during the maintaining the course in the first and second times

The values of the integral indicators have been improved at all stages. The integral indicator for course paper has been increased from 0,53 to 0,6 in general. This corresponds to 13% improvement.
Thank you for attention!

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