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A Method for Managing Engineers Training Processes using Swarm Intelligence Algorithms

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Features of the approach to the management of engineering education processes:

1) there is no systematic approach in managing the learning process;

2) making choice of learning materials students are usually guided only by their own experience and recommendations from people who have previously been trained;

3) the prospects for the development of the economy sectors and the prospective needs of the market for engineering workers are not taken into account.

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Problems to solve for improving the efficiency of managing the training of highly qualified engineers:

1) improving the professional orientation of future professionals using psychological tests;

2) improving the efficiency of information management of the professional competences of engineers by rationally selecting individual trajectories of student training, the possibility of prompt change of the course program, individual choice how long to learn the material;

3) analysis of the effectiveness of selected training trajectories and further objective information about the results of training.

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History and the present state of the issue

Methods of revitalizing educational activities (Mahmutov M.I., Lerner I.Y., Zarukina E.V., Loginova N.A., Novik M.M.)

Problem: no methods to build individual and collective trajectories to prepare engineers in accordance with the requirements of employers

Ways to improve the individualization of the e-learning process (Kosonogova M.A.)

Addressing the issue of improving the effectiveness of learning using electronic learning systems (Vorobkalov P.N.)

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A set of indicators to describe students

$$STUD = <LPK_{STUD}, DE_{STUD}, AD_{STUD,} RAD_{STUD}, SAD_{STUD}, ZP_{STUD}, ZMO_{STUD}, Tech_{STUD}, UPC_{STUD}, UT_{STUD}, UFL_{STUD}, R_{STUD}, ARI_{STUD}> \quad (1)$$

Level of professional knowledge of the student

$$UPC_{STUD}: \sum_{i=1}^{L} BDL_i, \quad (2)$$

Student rating based on learning outcome

$$R_{STUD} = R_{BASE} + R_{OLIMP} + R_{VAR} \quad (3)$$

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A set of customer requirements

$$OK = <VO_{OK}, STUD_{OK}, TE_{OK}, AD_{OK}, TST_{OK}, ZP_{OK}, AS_{OK}> \quad (4)$$

A set to describe a staff customer vacancy

$$Vo_{OK} = < lpk_{vo}, PK_{vo}, UPK_{VO}, Tech_{VO}, UTech_{VO}, UFL_{VO}> \quad (5)$$

The formula to determine the student's rating, from the customer's point of view

$$R_{STUD_{sex}} = F(\{\delta_{US_i}\}, \{US_i\}) \quad (6)$$

$$\{US_i\} = (LPK_{STUD}, RAD_{STUD}, ZP_{STUD}, ZMO_{STUD}, UT_{STUD}, UFL_{STUD})$$

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The procedure to determine δ_{USi}

1) For each string of the matrix the average geometric of its components is calculated:

$$\varpi_{USi} = \sqrt[N]{\prod_{i=1}^{N} a_{ij}}. \quad (7)$$

2) The importance ratios are calculated as the ratio of the average geometric corresponding line to the sum of the average geometric lines:

$$\delta_{USi} = \varpi_{USi} / \Sigma\varpi_{USi}. \quad (8)$$

Formula for selection of personnel by the customer

$$AS_{OK} = \sum_{i=1}^{N} \delta_{US_i} \cdot US_i. \quad (9)$$

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A way of selecting training courses using swarm intelligence algorithms

Step 1
- Direction for new courses for "scout bee" students are the most active, high-achieving students interested in new technologies

Step 2
- Directing students acting as "forage bees" on the trajectories of "scout bees" to the best and prospective courses, followed by comparing the results of trajectory construction with the results of "scout bees" and, if necessary, adjusting the parameters of the bee swarming algorithm to improve the trajectories of training

Step 3
- Formation of the trajectories of students' learning based on the firefly algorithm

Step 4
- Formation of the trajectories of students based on the algorithm of the ant colony in accordance with the needs of customers to obtain enough specialists in the promising areas of economic development

Step 5
- Formation of collective trajectories of student learning based on the algorithm of shoals of fish in the process of solving the problems of educational projects, preparation for the Olympics and competitions

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Training management method for IT-specialists

Stage 1. Assessing the development level of logical thinking of students

Step 1. Passing the R. Amthauer test, which allows to assess the structure of the student's intelligence

Step 2. Assessing a student's level of programming training

Stage 2. Determining the next step of preparation in the chosen direction

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Training management method for IT-specialists

Stage 3 (optional). Management of training to olympics programming

- ***Step 1.*** Passing tests for students to determine stress tolerance, adaptability, communication, selectivity and attention span
- ***Step 2.*** Students undergo computer training to increase stress resistance, adaptability, communication, concentration
- ***Step 3.*** Formation of proposals for the composition of teams based on the results of psychological tests
- ***Step 4.*** Adjusting the composition of the Olympic teams to take into account the wishes and preferences of students.
- ***Step 5.*** Conducting competitions and competitions with recommendations in the process of solving problems based on the algorithm of shoals of fish

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Training management method for IT-specialists

Stage 4
Management of training to industrial programming

- ***Step 1.*** Taking lessons and courses on industrial programming technologies.
- ***Step 2.*** Forming training project teams.
- ***Step 3.*** Distribution of tasks by the project team leader.
- ***Step 4.*** Problem solving by project teams.
- ***Step 5.*** Assessment of problem solving by project participants.

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Comparative analysis of the results of bachelor's degree in CSE and PI

The indicators, third-year	CSE	PI
1 Total number of students in the third year	19	26
2 Number of students who have completed training in IT-companies	2	3
3 Number of students who participated in the creation of software products registered in Rospatent	0	6
4 Number of students who have been employed without additional training in IT-companies	0	2
Fourth-year		
1 Total students in the fourth year	19	22
2 Number of students working in IT-companies	7	12
3 Number of students undergoing internships in IT-companies	2	4
4 Number of students who are prize-winners of IT-competitions	0	2
5 Number of students participating in IT-Olympics and competitions	1	7

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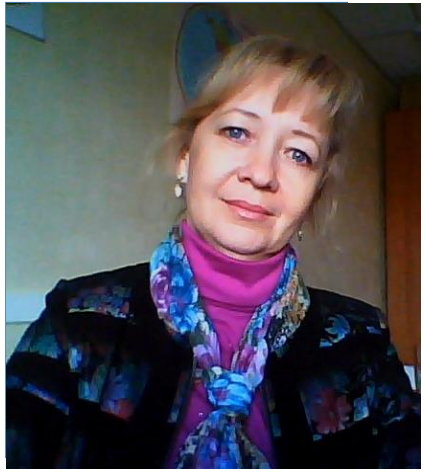
Thank you for attention!

Speacker's contacts:



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