Algorithm of Problem Solving in Educational Data Mining Approach

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Abstract[1]

The presented article "Algorithm of Problem Solving in Educational Data Mining Approach" is following in the previous article "Data Mining Tools in Science Education" (*Zaskodny,* 2012*, JSCI*)*. The main principle of previous article was data mining in science education as problem solving. The main goal was consisting in delimitation of complex data mining tool and partial data mining tool in area of science education. The procedure of previous article was consisting of data preprocessing in science education, data processing in science education, description of curricular process as complex data mining tool, description of analytical synthetic modeling as partial data mining tool and finally the application via physics education.*

The presented article is based on partly the widening of previous article, partly the innovation of previous article procedure, partly the presentation of new results. The presented article is respecting all the quoted sources which were utilized in the previous article (*Zaskodny,* 2012). *The presented article is also closely issuing from monographs processed by Zaskodny et al,.* 2014*, Zaskodny,* 2016.

The presented article is describing the role of algorithms in problem solving as significant result mainly of educational data mining approach, but also marginally of data mining approach in statistics and theory of financial derivatives (an expression of inter-disciplinary communication) The problem solving is expressing very often the essence of data mining and the algorithm of problem solving is showing the way how to reach the concrete results. It is showing not only how to substantiate the concrete results, but also how to continue by an expression of needful textbook structure (in the case of educational data mining approach) or how to continue in the form of programming language application (in the case of data mining in statistics and financial derivatives theory).

Within presented article it will be shown the concrete applications of problem solving by means of the algorithm of curricular process as complex tool of educational data mining. Also the algorithms of statistics and financial derivatives theory will be indicated.

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The structure of delimitation of the role of algorithm in problem solving (within educational data mining approach) will be described through following succession of steps:

1. Data Mining Approach as Realization of Data Mining Cycle
2. Complex Tool of Educational Data Mining – Curricular Process
3. Significant Partial Tool of Data Mining – Analytical Synthetic Modeling
4. Significant Partial Tool of Data Mining – Matrix Modeling and Main Diagonal of Matrix
5. Algorithm of Curricular Process
6. General Role of Algorithms in Data Mining Approach

Keywords: *Data mining, Data mining cycle, Educational data mining approach, Tools of educational data mining, Analytical synthetic modeling and problem solving, Matrix modeling and algorithm, Algorithm of problem solving, Algorithm of curricular process*

1. Data Mining Approach as Realization of Data Mining Cycle

1.1. Basic Structural Elements of Data Mining as Problem Solving

Data Mining – an analytical synthetic way of extraction of hidden and potentially useful information from the large data files (continuum data-information-knowledge, knowledge discovery). Described analytical synthetic way can be taken as the important assumption for problem solving by relevant scientific branch

Data Mining Techniques – system functions of the structure of formerly hidden relations and patterns (e.g. classification, association, clustering, prediction). The delimitation of system functions can be taken as the important assumption for structuring the relevant scientific branch

Data Mining Tool – a concrete procedure how to reach the intended system functions. Data Mining tools can be divided to the complex tools (the basic characteristics of relevant scientific branch) and to the partial tools (the essential procedures how to find the structures of problems solved)

Complex Tool – a resolution of the complex problem of relevant scientific branch (the succession of phases in the course of solution of complex problem, cumulatively it is connected with methodology of relevant scientific branch)

Partial Tool – a resolution of the partial problem of relevant scientific branch (the construction of global structure or partial structure of problems which are investigated by relevant scientific branch)

Result of Data Mining – a result of the data mining tool application (the described structure of methodology of relevant scientific branch, the description of structures of investigated partial problems). The significant way of structure description is given by algorithms of problem solving

Representation of Data Mining Result – model formalization of this, what is expressed (usually the formalization of model construction of problem resolution). The significant content of model formalization is connected with algorithms of problem solving

Visualization of Data Mining Result – optical shape of the data mining result (usually the optical visualization of model expression of problem resolution). The significant optical visualization is issued from algorithms of problem solving

1.2. Data Mining Approach

Data mining cycle is given by the succession of stages enabling to obtain the required results of data mining. Such succession is expressing the structure of data mining cycle. Data mining approach is connected with the sequential realization of individual stages, data mining approach is given by the global realization of data mining cycle structure. Educational data mining approach is connected with the transformations of educational contents, educational data mining approach is given by the global realization of transformations hidden inside data mining cycle.

The individual stages of data mining cycle will be described:

- Data Definition, Data Gathering (data accumulation in the relation to an identified problem)

- Data Preprocessing, Data Processing (progressive processing data on the basis of identified problem analysis, delimitation of partial problems)

- Data Mining Techniques, Data Mining Tools (the delimitation of system functions of formerly hidden relations and patterns, the application if concrete procedures in the course of problem solving, the delimitation of partial problems essence by means of abstraction)

- Discovering Knowledge, Discovering Patterns (transformation of data in the framework of a continuum data-information-knowledge). It can be described by means of synthesis as the intellectual reconstruction of identified problem in the form of algorithm of problem solving

- Representation of Data Mining Results, Visualization of Data Mining Results (usually a construction of structural model of worked problem out, an optical retrieval of reached results). It can be given by the structural model and optical retrieval in the light of problem solving algorithm

- Application (an utilization of the resolved problem for next development of scientific theory or for substantiation of practical application). It is connected with an utilization of problem solving algorithm

2. Complex Tool of Educational Data Mining

2.1. Classification of Tools in the Light of Algorithms

Dividing of data mining tools can be carried out into complex tools of data mining and partial tools of data mining. The complex tool is often connected with methodology of relevant scientific branch. The partial tool is often connected with construction of global structure or partial structure of problems investigated by relevant scientific branch.

The structure of methodology of relevant scientific branch can be taken as the result of complex tool application. The structure of problems investigated by relevant scientific branch can be taken as the result of partial tool application.

The significant way of structure description may be connected with the algorithms of problem solving. The role of algorithms in data mining approach could be in respective scientific branch explained by means of the complex and partial data mining tools – the result of data mining is given by the application of data mining tools.

2.2. Procedure of Complex Tool Seeking in Area of Science Education

The main base of sought procedure is educational data mining approach from the point of view of content pedagogy (see works of W.Doyle, 1992a, 1992b, 2003, see Zaskodny, 2009, 2015, 2016). The representation of education from the point of view of content pedagogy will be demonstrated by means of science education.

The main goal is consisting in delimitation of complex data mining tool. The procedure is consisting of data preprocessing in science education, data processing in science education, description of curricular process as complex data mining tool in science education and finally application.

2.3. Data Preprocessing in Science Education

The result of data preprocessing is given by "Educational Communication of Natural Science" (Zaskodny, 2012, 2015, 2016, Zaskodny et al., 2014) as the succession of transformations of education content forms:

- **The transformation T1** is transformation of scientific system of natural science to communicable scientific system of natural science (the first form of education content existence)
- **The transformation T2** is transformation of communicable scientific system of natural science to educational system of natural science (the second form of education content existence)
- **The transformation T3** is transformation of educational system of natural science to both instructional project of natural science and preparedness of

educator for education (the third and fourth forms of education content existence)

- The transformation T4 is transformation of both instructional project of natural science and preparedness of educator to results of education (the fifth form of education content existence)

- The transformation T5 is transformation of results of natural science education to applicable results of natural science education (the sixth form of education content existence)

2.4. Data Processing in Science Education

The result of data processing is given by “Curricular Process of Natural Science” as the succession of transformations of formalized education content forms arranged by algorithmic way (Zaskodny, 2012, 2015, 2016, Zaskodny et al., 2014).

The form of education content existence was called “**variant form of curriculum**”, the curriculum was connected with “**education content**” (Prucha, 2005).

The variant form of curriculum has got the universal structure created by four structural elements (Zaskodny, 2009, 2015) – sense and interpretation, set of objectives, conceptual knowledge system, factor of following transformation.

The variant forms of curriculum can be selected on the basis of fusion of Anglo-American curricular tradition and European didactic tradition (Zaskodny, 2009, 2015, 2016).

On the basis of introduced terminology the curricular process is defined as the succession of transformations T1-T5 of curriculum variant forms. The curricular process of natural science can be described by the following succession of curriculum variant forms:

- Conceptual curriculum as the communicable scientific system of natural science (output of T1, the first variant form of curriculum)

- Intended curriculum as the educational system of natural science (output of T2, the second variant form of curriculum)

- Projected curriculum as the instructional project of natural science (output of T2, the third variant form of curriculum)

- Implemented curriculum-1 as the preparedness of educator for education (output of T3, the fourth variant form of curriculum)

- Implemented curriculum-2 as the results of education (output of T4, the fifth variant form of curriculum

- Attained curriculum as the applicable results of education (output of T5, the sixth variant form of curriculum)

2.5. Complex Tool of Data Mining in Science Education

The complex tool of data mining in science education is given by curricular process of natural science.

The curricular process delimits the correct education content via succession of following curriculum variant forms:

- **Conceptual curriculum** (output of transformation T1)

- **Intended curriculum** (output of transformation T2)

- **Projected curriculum**, **Implemented curriculum-1** (outputs of transformation T3)

- **Implemented curriculum-2** (output of transformation T4)

- **Attained curriculum** (output of transformation T5)

2.6. Application of Complex Tool (Curricular Process) in Science Education

The application of complex tool in science education will be performed through physics education. The content of book "Curricular Process of Physics" (Zaskodny, 2015) is showing how to apply the curricular process in concrete natural science – in physics.

The brief description of mentioned book contents can be presented by means of following form:

A. Introduction I (Delimitation of curricular process of physics), **Introduction II** (Structure of physics)

B. Construction and representation of curriculum variant form

i) Conceptual curriculum (Statistical and non-statistical physics, classical dimension, quantum dimension, relativistic dimension, scientific structural models)

ii) Intended curriculum (Adaption of scientific structural models to possibilities of addressees of education – creation of cognitive models)

iii) Projected curriculum (Projection of cognitive models within creation of textbooks system for classical, quantum, relativistic dimension of statistical and non-statistical physics)

iv) Implemented curriculum-1 (Physics teacher preparedness for education of physics concrete theme adjusted to addressees possibilities – mediated solution of problems)

v) Implemented curriculum-2 (Detection of results achieved by physics instruction with utilization of appropriate test techniques)

vi) Attained curriculum (Detection of which achieved results can be applied in practice)

C. Workout of curricular process of physics (including the model of content pedagogy and model of physics education)

D. Workout of relevant parts of physics

3. Significant Partial Tool of Data Mining – Analytical Synthetic Modeling

3.1. Universal Analytical Synthetic Modeling

Significant partial tool of data mining is given by analytical synthetic modeling. Analytical synthetic modeling describes the mediated or real problem solving. In the case of educational data mining approach the analytical synthetic modeling can be connected with the inputs and outputs of individual transformations T1-T5. The description of universal analytical synthetic modeling is realized by means of visualization Vis.1 and legend to Vis.1.

Legend to Vis.1

a

Identified complex problem – investigated area of reality, investigated phenomenon

$\boldsymbol{B_k}$

Analysis – Analytical segmentation of complex problem to partial problems

$\boldsymbol{b_k}$

Partial problems PP-k – Results of analysis: Essential attributes and features of investigated phenomenon

$\boldsymbol{C_k}$

Abstraction – Delimitation of partial problems essences through abstraction with goal to acquire the partial solutions

$\boldsymbol{c_k}$

Partial solutions PS-k – Results of abstraction: Partial concepts, partial pieces of knowledge, various relations, etc.

D_k

Synthesis – Synthetic finding dependences among results of abstraction

d_k

Partial conclusions PC-k – Results of synthesis: Principle, law, dependence, continuity

E_k

Intellectual reconstruction – Intellectual reconstruction of investigated phenomenon, investigated area
of reality

e

Total solution of complex problem ”*a*” – Result of intellectual reconstruction: Analytical synthetic structure of final knowledge (conceptual knowledge system)

3.2. Illustration of Analytical Synthetic Modeling in Science Education

The application of analytical synthetic modeling is presented by means of visualization Vis.2 from the area of physics education.

The visualization Vis.2 is analytical synthetic model of relativistic non-statistical physics (classical mechanics, special theory of relativity, general theory of relativity).

This visualization constitutes a part of physics conceptual curriculum as a part of communicable scientific system of physics (a part of output of transformation T1).

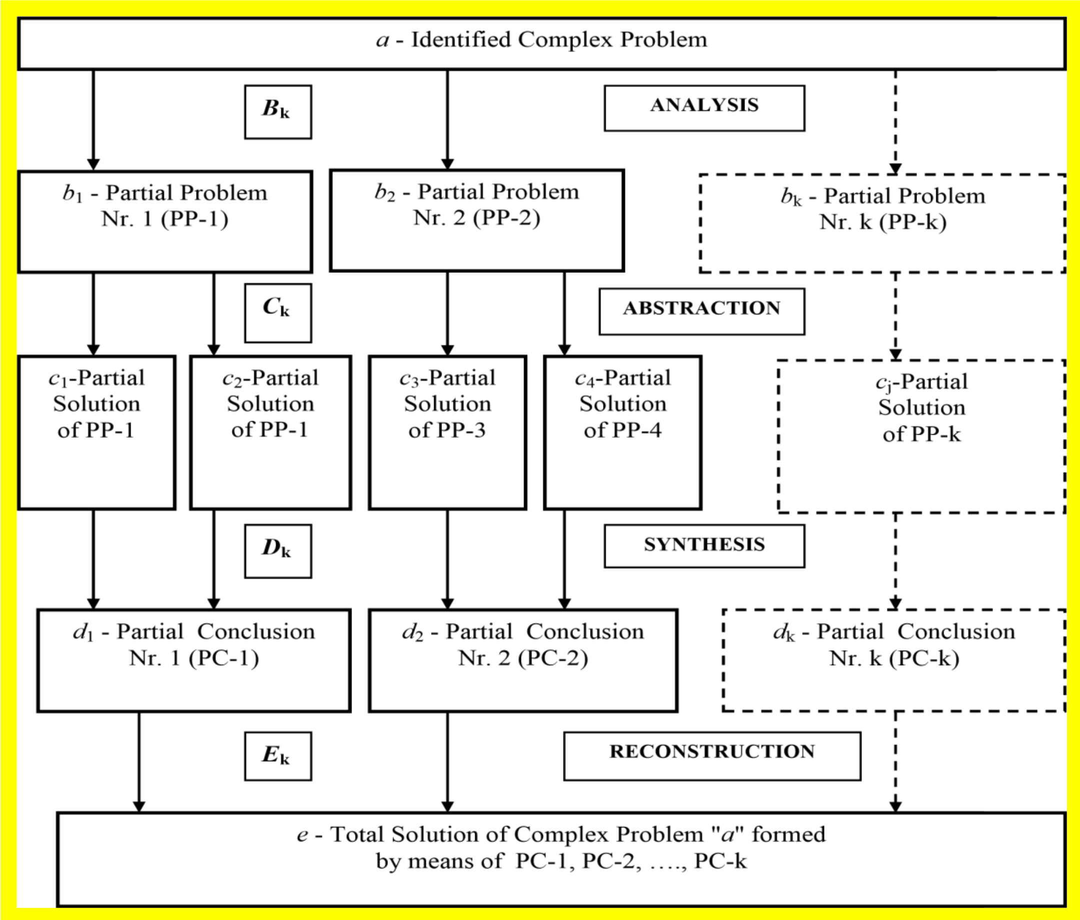
The presented analytical synthetic model was taken over from book “Survey of Principles of Theoretical Physics” (Zaskodny 2014, 2018).

4. Significant Partial Tool of Data Mining – Matrix Modeling and Main Diagonal of Matrix

4.1. Representation of Matrix Model of Complex Problem Solving

The formal expression of matrix modeling is given by visualization Vis.3 (Zaskodny 2015). It is necessary to differ the matrix model of cognitive structure (it can be used in the case of educational data mining approach) and the matrix model of scientific structure (it could be used, for example, in the cases of data mining approach to theory of financial derivatives or to theory of probability and statistics).

Vis.1: Universal Analytical Synthetic Model of Problem Solving (Zaskodny, 2016)

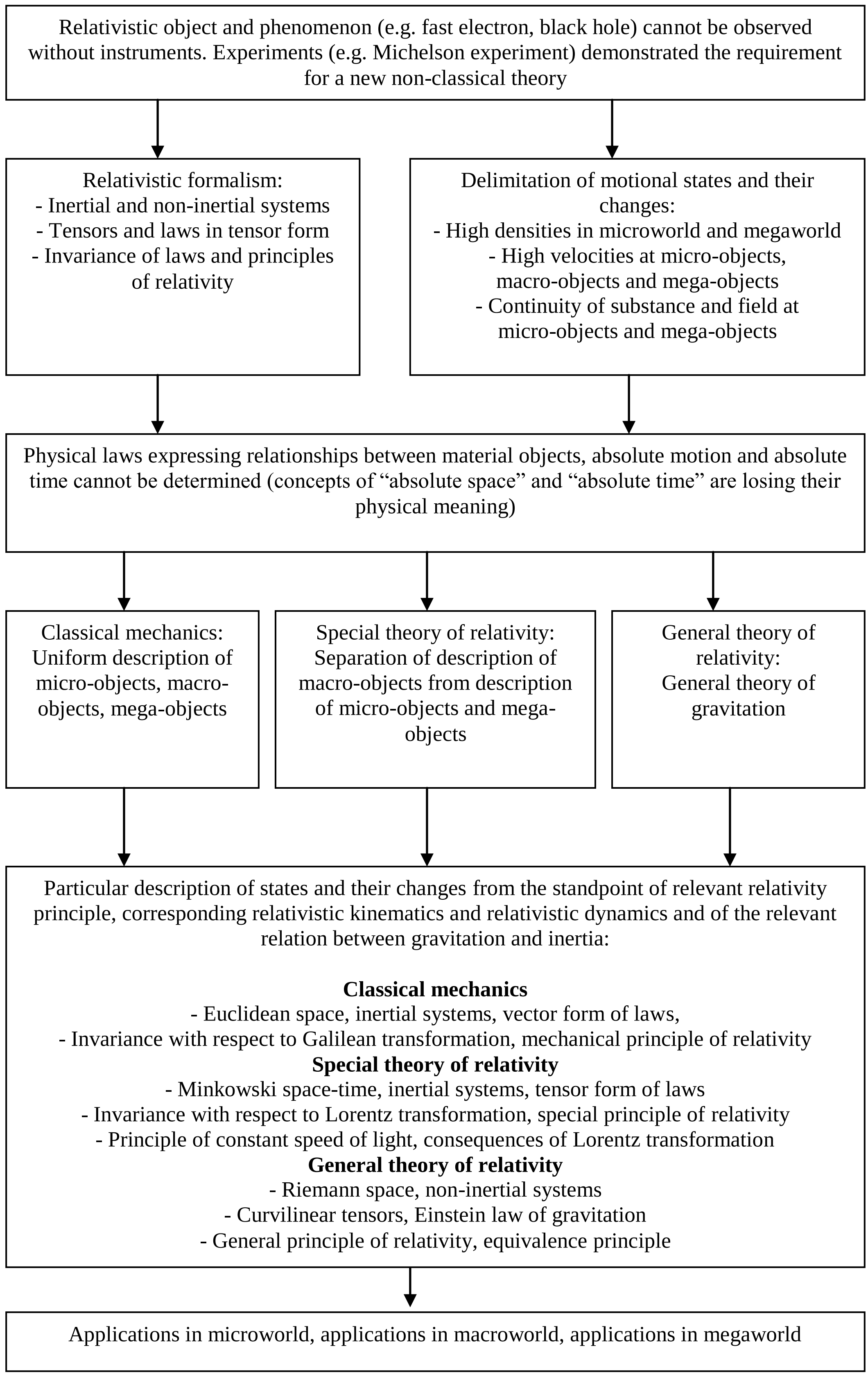


The elements of main diagonal form a definition line of matrix. A linear arrangement of such elements in the shape of main diagonal is representing the algorithm of problem solving within relevant data mining approach. The delimitation of definition line of matrix is starting from linear arrangement of the analytical synthetic model of scientific or cognitive structur

4.2. Description of Matrix Model and Its Main Diagonal

Within the framework of creation of matrix model of scientific or cognitive structure it is first of all necessary to delimit by linear way the survey of concurring elements of matrix main diagonal. The brief description of their contents is needful to perform. The delimitation of matrix definition line is starting from linear arrangement of respective analytical synthetic model.

Vis.2: Analytical synthetic model of relativistic non-statistical physics (Zaskodny 2014)



Vis.3: The matrix model of complex problem solving

1	=	=	=																	
=	2	=	=		I															
=	=	3	=																	
=	=	=	4	=	=	=	=													
			=	5	+	+	+													
			=	+	6	+	+		II											
			=	+	+	7	=													
			=	+	+	=	8	=												
							=	9	=	=	=	=	=							
								=	10	+	=	=	=							
								=	+	11	=	=	=		III					
								=	=	=	12	+	=							
								=	=	=	+	13	=							
								=	=	=	=	=	14	=	=	=	=			
													=	15	+	+	=			
													=	+	16	+	=		IV	
													=	+	+	17	=			
													=	=	=	=	18	=	=	=
																	=	19	+	+
															V		=	+	20	+
																	=	+	+	21

Often it is possible to take the important segments of definition line as the partial conclusions d_k of analytical synthetic model (see Vis.1). Afterwards it is possible to complete such segments by the found essences c_k, eventually by the partial problems b_k (again see Vis.1).

The projection of definition line into creation of textbook should enable to realize the mediated problem solving in the cooperation of education addressees and teacher. The projection of definition line into solution of scientific task should run in the framework of scientific community. In general the projection of definition line into mediated or real problem solving should enable to carry out the intellectual reconstruction "*e*" of identified problem "*a*" (see Vis.1).

The definition line of matrix (see Vis.3) contains hypothetically 21 elements (21 subject matter units or 21 scientific pieces of knowledge). The individual subject matter units or scientific pieces of knowledge were marked by numbers from 1 to 21 and they occupy the matrix main diagonal.

The construction of matrix model of scientific or cognitive structure with 21 elements of main diagonal will be described in the following way. Resulted matrix will be squared with 21 matrix rows and 21 matrix columns. The numeral succession of sequential numbers will be written down into main diagonal – definition line. The being relations (associations and discriminations) among 21 elements of definition line will be plotted in matrix. The associations will be marked by =, the discriminations by +.

In the course of developing the same group of subject matter units or the same group of knowledge scientific pieces, the elements are associated on the basis of their logical continuities. In the course of developing the same group of subject matter units or the same group of knowledge scientific pieces, the elements are discriminated on the basis of their diverse properties.

The matrix element given by i-th row and j-th column bears the usual indication a_{ij}. Element a_{ij} remains empty if none of delimited relations (association or discrimination) is between elements a_{ii} and a_{jj} of definition line.

In the course of matrix filling the definition line elements a_{11} and a_{22} will be investigated at the earliest. The relation between them is given by association = or discrimination +, the element a_{12} will be marked = or +. All the elements a_{ij} for index j greater than index i will be gradually explored by this way. Thus the elements above definition line will be marked or unmarked. The verification of analysis correctness of relations between the definition line elements may be confirmed by the execution of this analysis in contrary order – at the earliest the relation of elements $a_{21,21}$ and $a_{20,20}$ will be determined, then $a_{20,20}$ and $a_{19,19}$ etc.

Subsequently the elements a_{ij} for index i greater than index j will be marked or unmarked. The both halves of filled matrix should be axially symmetrical according to definition line. In the case of symmetry the analysis of relations among the definition line elements was carried out correctly.

The matrix capable of interpretation should have marked all the elements a_{ij} for j=i+1 and i=j+1 (so called ideal matrix). Mistaken construction of matrix (caused, for example, by a bad order of definition line elements) shows itself by disturbance of matrix ideality.

The clusters of marked elements, grouped together around the definition line part, are important. Such clusters indicate the close associations and discriminations among corresponding elements of mentioned part of definition line. The definition line elements of such cluster contribute to delimitation of the same conceptual knowledge system. In the case of educational data mining approach the described clusters can be interpreted as the manifestation of curriculum variant forms. In the case of non-educational data mining approach the described clusters can be connected with a scientific conceptual knowledge system.

From the matrix model the partial curriculum variant forms or the partial scientific conceptual knowledge system can be identified. The matrix represented by Vis.3 contains five hypothetical curriculum variant forms or scientific conceptual knowledge system. Their marking is given by Roman numerals I, II, III, IV, V.

The matrix main diagonal can be connected with the algorithm of problem solving. The respective problem was primarily investigated through analytical synthetic model (see Vis.1), secondarily through matrix model (see Vis.3). On the basis of matrix main diagonal the third step can be realized. In the case of educational data mining approach the found algorithm enables, for example, to suggest the succession of chapters for future textbook. In the case of non-educational data mining approach the found algorithm enables, for example, to suggest the appropriate programming language for software creation.

5. Algorithm of Curricular Process

5.1. Possibility of Collaboration of European and Anglo-American Conception

The representation of education from the point of view of content pedagogy was carried out through science education and illustrated through physics education.

This representation was realized by data preprocessing in science education, by data processing in science education, by description of curricular process as complex data mining tool in science education, and finally by application.

The basic result of data mining approach in science education is comparison of transformations of relevant natural science knowledge with curriculum variant forms. Organized sequence of these transformations is the expression of educational communication of respective natural science, organized sequence of curriculum variant forms is the expression of curricular process.

The communicative conception of science education was defined in the Czech-Slovak conception (Brockmeyerova, 1982, Tarabek, Zaskodny, 2009, 2010, 2011) – and may be in conjunction with continental Europe (European didactic tradition). The interdisciplinary cooperation with relevant natural science was pointed out. On the other hand, several forms of education content were described in Anglo-American conception (Pasch et al., 1995, 2005, Cetron, Gayle, 1991) – for example, five curriculum concepts delimited by M.Cetron and M.Gayle (Anglo-American curricular tradition).

The "assimilation" of science education with natural science in European conception and the "assimilation" of science education with educational science in Anglo-American conception enabled to suggest the collaboration of the both conceptions. For the first time it was suggested by W.Doyle, J.Prucha, P.Tarabek, P.Zaskodny (Doyle, 1992a, 1992b, 2003, Prucha, 2005, Tarabek, Zaskodny, 2008a, 2008b, 2008c). In the present time the continuation of European and Anglo-American conception fusion is substantiated by the works of P.Tarabek (presently only in memoriam) and P.Zaskodny (Tarabek, Zaskodny, 2011, 2012, 2013, 2014, Zaskodny 2016, 2018).

The algorithm of curricular process expresses the hopeful way for fusion of European communicative conception and Anglo-American curricular conception.

Such hopeful way would enable to work with idea of C.Wieman (recipient of the Nobel Prize in 2001) – “Why not try a scientific approach to science education?” (www.cwsei.ubc.ca).

5.2. Analytical Synthetic Model of Science Education

According to J.Brockmeyer (Brockmeyerova, 1982) and P.Tarabek, P.Zaskodny (Tarabek, Zaskodny, 2009, 2010, 2011, 2012) the subject of science education is a whole continuous process of forwarding and mediation of results and methods of natural science knowledge to the mind of individuals who are not directly bounded with the knowledge creation. This process is leading to the transfer of natural science knowledge to the consciousness of whole society. This process is done by various participants with educational intention and includes not only the teaching and education in all the levels of educational system but also lifelong studies carried out institutionally and information transfer from natural science to society.

Due to science education defined subject it will be effective to remind the main structural elements of science education and continuously describe them by the survey of substantial concepts. The reminder of it is connected with the delimitation of respective natural science curricular process as the complex tool of educational data mining.

The problem solving of structural elements and substantial concepts of curricular process was historically given by the construction of analytical synthetic model of science education and definition line of matrix model. Such structural orientation cannot, however, be confused with a continuous and coherent study of relevant natural science theory as a separate scientific discipline.

The derivation of matrix definition line (algorithm of curricular process) should emanate from analytical synthetic model of the structure of science education as a whole. Such model has been published in works of P.Zaskodny (Zaskodny, 2015, Zaskodny, 2018, Zaskodny et al., 2014) and it was highlighted the substantiation of this model by analytical synthetic model of content pedagogy (Zaskodny, 2015, Zaskodny et al., 2014). The analytical synthetic model of science education as a whole was used for the immediate classification of curriculum variant forms and for the immediate location of previous and follow-up consequences. As each analytical synthetic model, also this analytical synthetic model has got a significant cognitive dimension – it is showing which the operations of analysis, abstraction and synthesis must be carried out for the completion of curriculum variant forms system.

5.3. Individual Steps of Curricular Process Algorithm

The creation of matrix model definition line should reflect the general matrix model represented by visualization Vis.3 and the description of relevant natural science curricular process. The application of matrix model definition line could be essential for persons interested in deeper understanding the methodology of science education.

The clusters of definition line elements forming the main problem areas of science education should be classified according to the shape of definition line as a whole. The order of these clusters can be identified with the succession of curriculum variant forms forming the curricular process. This succession can be taken over from the description of data mining complex tool in science education. The single members of this succession (Conceptual curriculum, Intended curriculum, Projected curriculum, Implemented curriculum-1, Implemented curriculum-2, Attained curriculum) can be identified with individual steps of curricular process algorithm.

The algorithm of natural science curricular process will be now described more detailed. For reinforcement of fusion of European and Anglo-American science education conception it will be presented the relations to literature sources, especially to five curriculum concepts of M.Cetron and M.Gayle (Cetron, Gayle, 1991, Prucha, 2005). The algorithm of natural science curricular process is created by the succession of following steps:

i) Conceptual curriculum
Curriculum variant form in literature: Conceptual form as the conception of education content in schools
Curriculum concept (Cetron, Gayle, 1991): The concept related to the scientific structure of learning, the subject matter as a summation of knowledge items of particular science
Curricular process as data mining complex tool: The output of transformation T1

ii) Intended curriculum
Curriculum variant form in literature: Intended curriculum as the planned goals and content of education with the explicit definition in curriculum

documents (three categories of content – content of education, operational level, prospects level)
Curriculum concept (Cetron, Gayle, 1991): The concept related to the adjusted structure of learning, the subject matter as a summation of knowledge items of particular science
Curricular process as data mining complex tool: The output of transformation T2

iii) Projected curriculum
Curriculum variant form in literature: Project form in the relation to the concrete planned projects of education content, the education content presented to the education addressees
Curriculum concept (Cetron, Gayle, 1991): The concept related to the technology of teaching, the learning focused on the method of imparting
Curricular process as data mining complex tool: The partial output of transformation T3

iv) Implemented curriculum-1
Curriculum variant form in literature: Realization form in the relation to the concrete planned projects of educator training
Curriculum concept (Cetron, Gayle, 1991): The concept related to the development of cognitive processes, the thinking is more important than the facts
Curricular process as data mining complex tool: The partial output of transformation T3

v) Implemented curriculum-2
Curriculum variant form in literature: Resulting form in the relation to the education content accepted by the education addressees
Curriculum concept (Cetron, Gayle, 1991): The concept related to education addressees´ self-realization and giving the learner space to discover the world through the education addressees´ activities, arising from the education addressees´ interests
Curricular process as data mining complex tool: The output of transformation T4

vi) Attained curriculum
Curriculum variant form in literature: Effect form in the relation to an achieved curriculum and to an acquired knowledge modified by education addressees in the term of their own experiences and interests
Curriculum concept (Cetron, Gayle, 1991): The concept related to rectification of society by means of the solving society´s abuses through education
Curricular process as data mining complex tool: The output of transformation T5

6. General Role of Algorithms in Data Mining Approach

6.1. Brief Description of Role

The role of algorithms in data mining approach will be described by means of three conclusions created on the basis of the generalization of reached results.

The first conclusion:

Data mining approach is given by the global realization of data mining cycle structure. Data mining approach is closely associated with problem solving. And the resolution of concrete identified problem is usually given by the location of algorithm how to reach the intellectual reconstruction of identified problem.

The second conclusion:

Data mining tool is defined as a concrete procedure how to reach the results of data mining approach. Data mining tools can be divided to the complex tools (e.g. structured methodology of relevant scientific branch) and to the partial tools (the essential procedures how to find the structures of problems solved).

The described structure of methodology of relevant scientific branch can be taken as the result of complex tool application, the descriptions of structures of investigated partial problems of relevant scientific branch can be taken as the results of partial tools applications.

The significant way of structure description may be connected with the algorithms of relevant problem solving. The role of algorithms in data mining approach could be explained in respective scientific branch by means of the complex and partial data mining tools.

The third conclusion:

The significant data mining tools are analytical synthetic modeling and matrix modeling. In the framework of creation of matrix model of scientific or cognitive structure it is first of all necessary to delimit the survey of follow-up elements of matrix main diagonal by linear way. The brief description of their contents is needful to perform. The delimitation of matrix definition line is starting from linear arrangement of analytical synthetic model of scientific or cognitive structure. The important segments of definition line can be identified with partial conclusions d_k of analytical synthetic model (see Vis.1).

The matrix main diagonal, i.e. matrix definition line, can be by the carrier of algorithm describing the result of data mining approach or the way of application of data mining tools. The role of algorithms in data mining approach is connected with the discovery of definition line of matrix model.

6.2. Illustration of Data Mining Approach Algorithms

For substantiation of “Algorithm of problem solving in science education” the concrete algorithm (the matrix main diagonal) of curricular process was delimited in the shape

i) Conceptual curriculum
ii) Intended curriculum
iii) Projected curriculum
iv) Implemented curriculum-1
v) Implemented curriculum-2
vi) Attained curriculum

The curricular process was characterized as the complex tool of educational data mining approach in the area of science education. The applications of presented algorithm of curricular process were shown by means of works Vesela, 2014, Bartonova, 2014. The mentioned applications have represented the way from algorithm (matrix main diagonal) to succession of educational text chapters (with possibility of e-learning).

For substantiation of “Algorithm of problem solving in statistics” the concrete algorithm (the matrix main diagonal) of statistics and probability can be suggested in the shape

i) Formulation of statistical investigation
ii) Creation of scale
iii) Measurement in descriptive statistics, statistical probability
iv) Elementary statistical processing
v) Non-parametric testing, continuous and discrete probability distribution
vi) Theory of estimations
vii) Parametric testing
viii) Regression and correlation analysis

The applications of suggested algorithm of statistics were shown by means of works Dang Thi Thu Hien, 2014, Fasura, 2014, Masna, 2014, Vlcek, 2014. The mentioned applications have represented the way from algorithm (matrix main diagonal) to concrete problems solving (with possibility of programming).

For substantiation of “Algorithm of problem solving in financial derivatives theory” the practical algorithm (matrix main diagonal) of option pricing and hedging can be suggested in the shape

i) Selecting a suitable type of a discrete option pricing model

ii) Defining the origins of the growth and decline indices (implied or autonomous model)
iii) Calculating of underlying instrument prices and theoretically correct option prices
iv) Selecting the appropriate equations and formulae to prepare the implementation of delta hedge
v) Developing a dynamic delta hedge strategy
vi) Delta rebalancing
vii) Selecting the appropriate equations and formulae to prepare the implementation of gamma hedge
viii) Developing a dynamic gamma hedge strategy
ix) Gamma rebalancing
x) Preparing and implementing other option hedging types that have been selected

The practical algorithm of option pricing and hedging can be taken as one from soled problems in the area of financial derivatives theory. The applications of the suggested algorithm of option pricing and hedging were shown by means of works Pavlat, 2014, Havlicek, Zaskodny, 2014, Pasta, 2014, Risky, 2014, Soucek, 2014, Sebest, 2014. The mentioned applications have represented the way from algorithm to software.

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