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EDUCATION MODEL FOR MIRIS METHODOLOGY
MODEL OBRAZOVANJA ZA METODIKU MIRIS

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Abstract:

The paper presents the MIRIS methodology and education model that may help in acquiring knowledge and skills required in information system design. The education model is used with students, as well as with information technology (IT) professionals actively involved in information systems design. The model was changed during the course of time, and teaching made a shift from academic exposition towards communication and team-oriented modeling. The results are based on years long education. Results obtained by IT professionals were measured and the rate of successfully passed exams for information systems designer was recorded during a longer period of time.

Sažetak:

U ovom radu prikazana je metodika MIRIS i model obrazovanja pomoću kojeg se može steći znanje i vještina projektiranja informacijskih sustava po spomenutoj metodici. Model obrazovanja je primijenjen na studentima. Pored toga model je primjenjen i na profesionalcima informatičke tehnologije (IT) koji se aktivno bave razvojem informacijskih sustava. Tijekom vremena model je mijenjan, a nastava se pomakla od akademskog izlaganja metoda ka komunikacijskom timskom modeliranju. Rezultati su zasnovani na višegodišnjem obrazovanju. Mjerenje je izvršeno na IT profesionalcima i praćen je broj uspješno položenih ispita za projektanta informacijskih sustava tijekom dužeg vremenskog razdoblja.

1. Introduction

Learning the MIRIS methodology is an education process for designers of information systems, aiming to produce a model of business system that can be a basis for building an information system. Teaching models have been improved during past twenty years by the authors due to the following reasons: improving of methodology and methods, emphasizing particular didactic approaches and practical work in education of information system designers.

The goal of educating designers is acquisition of knowledge and skills in designing and documenting information systems. Teaching is based on design methods accepted and required by MIRIS methodology. Two methods are taught: analysis of organization systems, process design, data modeling with databases, application design and phases and activities of life cycle of an information system.

Training is based on various didactic theories, with prominent role of didactic as a curriculum theory, i.e., objective approach /1/.

Implementation of information system designers education includes application of various models of work. Education has been performed since 1984, so extensive experiences were gained. Since 1984, 16 one-day seminars, 24 weekly coursers, 14 one-year studies were performed, involving ten generations of full-time students (approximately 30 students per year). More than 1000 attendants were included, where courses and one-year study included more than 500 designers having practical experience in development of information systems /2/.

Attendants are students or employees of various professions: analysts, organizers, designers, database administrators, programmers and information technology (IT) managers.

Teachers are experienced designers and pedagogues since such training requires experience in design.

Attendants' competence to carry out projects was studied. There were a few competent designers, so the teaching model was modified in order to increase the design skills.

Due to rather low rate of using knowledge, teaching was improved over the time.

This paper presents experiences in education of IT professionals working in data processing centers in various companies (andragogy in design school through seminars) and IT students. The topics issues taught are standard methods for designing information systems as defined in MIRIS methodology.

2. The MIRIS methodology

The MIRIS methodology MIRIS (acronym from croatian Metodika za Razvoj Informacijskog Sustava = Methodology for Development of Information System) is a set of methods and activities in time, where objectives are designing and building an information system (IS)./3/ It has been developed since 1984 and it was published in 1995.

Education of information system designers for the MIRIS methodology has been developed and improved from its beginning till nowadays. Designers (students) were taught about all phases of information system development, methods used at particular phases, software tools for designing and building information system, communication among information technology professionals and users.

The MIRIS methodology included methods proven in practice (HRT, MORH, Ministarstvo vanjskih poslova, Croatia osiguranje d.d., Croatia banka, Županija Primorsko-goranska, Hrvatske šume, HOO, PLIVA, Badel and other companies).

The methodology established development phases and activities within a particular phase as detailed as required. Further, the methodology defines relations between particular activities and sets sequence of performance. It defines when to start and when to finish certain activity, which data (information, models) are included in an activity, which are the results of a given activity. A method used is determined for each activity as well as the quality of output documentation.

Methodologies are complex issues and can be considered from the various points of view. In the light of information system process structure, methodology is defined as a set of modeling activities, grouped in phases, where activities within one single phase are mainly performed around on the basis of one cohesive model.

Requests, problems and obstacles in building a quality and productive methodology for designing information systems are numerous. One of these is training of designers in order to make the methodology their usable intellectual tool.

The process of designing is set forth step-by-step, from an idea to the implemented program. Each step is described. In design practice, cases and respective solutions are analyzed. Students follow the process of considering the problem and set of all designers' ideas, critically estimate these until acceptable solutions are reached. Designing is followed "live". Students are encouraged to work in team

and they learn on errors together. Examples for independent work are given and then their independent solutions are considered and analyzed.

3. Life cycle of the MIRIS methodology

Researches on presenting knowledge in the information design field aim to define a method that directly creates reality models, which help in implementing an information system in the existing IT. The problem is to find an accurate method for recording the relevant knowledge. Basic principles of organization are used in modeling, such as: classification, aggregation, generalization and hierarchy. /**4**/

There is no common opinion on main unsolved problems in presenting knowledge, not even in, for example, narrower filed of object oriented design using languages UML and OML, however, combination of various approaches can be found /**5**/.

Basically, phases of the life cycle according to the waterfall model are as follows: basic design, realization and maintenance or analysis, design and implementation /**6**/ where activities referring to particular phases and evaluation of the system during the maintenance phase overlap.

Detailed division of life cycle by phases is: strategy - why (problem definition), analysis what (analysis of a problem), design - how (elaboration of a solution), development i.e., programming - realization (creation of an IS), testing - quality assessment (checking), implementation - the first application with test – and maintenance /**7**/.

According to the prototype model, which was used very early and it was well studied and presented in a number of works, basically one phase is added, namely the "prototype making", which at very early stage provides a picture how the completed system would look like.

Yourdon presented the life cycle, using his own method for process modeling, as a network of linked processes /**8**/.

The MIRIS methodology was developed through expansion of and learning from other methodologies and testing methods in research projects /**9**/. It was tested in approximately hundred projects of various sizes and it was improved on the fly.

Methods in the MIRIS methodology are similar to numerous methods in other methodologies. The MIRIS methodology uses three basic methods, namely: data modeling method, process modeling method and application modeling method. Phases of the life cycle in the MIRIS methodology are divided in two groups of phases: logical modeling (IS design) shown in Table 1 and physical modeling (building IS) shown in Table 2. Each group has three phases, so there are six phases in total (in previous version there were seven phases defined). Phases are further divided in activities. /**10**/

4. Model for teaching IS Design

On the basis of the development of information systems phases and methods therein used for training information system designers, a training model for the MIRIS methodology is defined, as shown in Table 3. Number of seminars is not compliant with phases or design sequence, rather, it has origins in years long research of the contents and sequence that produced the best results in training.

Training of designers consists of logical parts (seminars), which are performed according to the defined sequence and durations with mandatory pauses between seminars, as pauses are required for independent work on own project.

Seminars mentioned above are grouped in larger units and daily plans for teaching are made. Courses for students can be organized during one, or even better, during two academic years.

Courses for designers with experience in IS development last between 6 and 12 months, however, 5 hours of lessons a day is the upper limit.

A pause between two lessons is necessary for independent and team design exercises, which are tested in Design Practice seminars.

Table 1: Logical modeling - design

Phase 1: STRATEGIC PLANNING OF IS (SP)
1.1 Analysis: Defining and training a team, decomposition of a process, list of documentation and navigation through the system
1.2 Subsystems: Defining subsystems and relations
1.3 Priorities: Determining priorities
1.4 Resources : Defining complete infrastructure
1.5 Plan: Planning main project and activities
Phase 2: MAIN PROJECT (MP)
2.1 PT : Drawing up project task
2.2 DTP: Interview, analysis and process modeling (DTP)
2.3 MP Processes: Analysis of process, problem and proposal for improvements
2.4 MP Data: Data description
2.5 MP Plan: Planning project realizations
2.6 MP Resources: Defining resource models of the main project
Phase 3: PROJECT REALIZATION(PR)
3.1 DEV: Interview, abstraction and data modeling (EV)
3.2 Translation: Translation of data model into DB scheme (RM)
3.3 PR Architecture: Defining architecture of program product (APP)
3.4 PR Operations: Design of operation on DB scheme

Table 2: Physical modeling – building

Phase 4: : SOFTWARE REALIZATION (SR)
4.1 Designing physical data base
4.2 Registering DB scheme in data dictionary
4.3 Producing prototype and generating application tree
4.4 4GL or 3GL programming
4.5 Writing instructions and explanation of program solutions
4.6 Entering test data in BP and testing
Phase 5: IMPLEMENTATION AND APPLICATION (IAA)
5.1 Training user
5.2 Entering initial data in data base
5.3 Testing suitability to users' requirements
5.4 Writing help system for users
5.5 Optimization and parallel work of the new and old system
5.6 Final testing - delivery
5.7 Application of program product
Phase 6: MAINTENANCE (MAI) Performing previous activities in order to: introduce new business processes, replace existing business processes and correct errors

Table 3: Model of teaching for the MIRIS methodology

Introduction to information system design (2 hours)
Conceptual modeling and designing data base (18 hours)
- pause of at least 2 weeks for work on the project
Strategic planning of information system (5 hours)
Design practice - data bases (5 hours)
- pause of at least 4 weeks for work on the project
Operation analysis and process modeling (10 hours)
Design practice - Operation analysis (5 hours)
- pause of at least 4 weeks for work on the project
Quality assurance in IS design (5 hours)
Program design (8 hours)
Development of prototype (2 hours)
Design practice - production of the project (5 hours)
- pause of at least 3 months for solving the project
Exam

Students who complete all seminars and realize a project, sit for exam for information system designer. The most important element of the exam is advocating of own, or, what is better, team and more complex project.

Examples of answers given during seminars:

- Requirements changed during the realization of a project - what to do?
- How to document a project?
- Standardization of projects and methods.
- Planning and management of development.
- Distribution of tasks, etc.

Implementation and maintenance of program support, being two last phases according to the MIRIS methodology, are not presented as separate units during seminars and they cannot be practically taught in seminars. Rather, discussion on these topics is initiated within other seminars.

Scope, depth and sequence of curriculum are defined for each seminar. These are three basic didactic dimensions of teaching, aiming to a successful teaching.

Scope of curriculum is the issue of extent of knowledge and skills that designers should acquire and develop during particular seminar. This is a dynamical category and it leads to the conclusion that entire topics become superfluous. So, entire chapters were excluded, such as: hierarchy database, functional model of data base and similar.

The depth of curriculum changes over time. Some topics are presented as a mere information, such as normalization, while others become more important.

The sequence of presenting the curriculum is based on the following principles:

- from easier to more difficult,
- from known to unknown,
- from simple to more complex,
- from existing to desired,
- from programming practice to abstract modeling of a system.

Therefore, the sequence of seminars does not follow the phases of the IS development life cycle, which was an important discovery, resulting from years long critical reflections on teaching.

5. Topics in IS design seminar

Topic covered in particular seminars aiming to teach designers to understand and use the MIRIS methodology are discussed in this chapter.

5.1 Introduction to information systems design (IISD)

Trends in IS development; Planning and management of IS development; What kind of IS is required? Problems in IS development; Prototype development; Phases in development; Methodology; Methods; Models; System theory; Structure of information system; Organizational system; Team work; Who is who in IS development.

5.2 Conceptual modeling and development of data base (DDB)

Abstraction; Method entitiy-relations (ER); Structure of ER: entity; relation; attribute; aggregation, …; Constraints in ER: relationship's and attribute's cardinality, …; Data analysis in documents and respective modeling; Independent and team modeling. Database; 4GL; Data dictionary; Relational model: relation, attribute, domain, candidate for key, relation key, external key, constraints, relational operators, operator, normalization. Translation of ER into a relational model. Object oriented approach, UML/OML. Executive project. Exercise in modeling.

5.3 Strategic planning of information systems (PLAN)

Methods for strategic planning, business processes and functional, data classes, business goals and their decomposition, position on market, planned development, functions of IS, levels, diagonalisation of matrix, priorities in subsystems, infrastructure and information technologies, IT implementation plan, cost effective development, Nolan, Boehm, re-engineering of business processes, project management, work with examples, SPIN: Methodology for strategic planning of IS.

5.4 Design practice (DES)

Solving examples, team modeling, case analysis, realization of own project, interview exercise. Review and suggestions for models in our work.

5.5 Analysis of business and process modelling (ANA)

System analysis; Master project; Project Task; Team analysis; Data flow chart: data flow, process, data storage, external systems, decomposition, context chart, hierarchical description, process types, balance, recommendations for drawing, constraints, interview, practical representation of structural research, recognition of process and data flow, How to develop the IS in a company; Analysis and modeling using students' examples.

5.6 Quality assurance in IS design (QUAL)

Methods of quality assurance in design and implementation of IS: ISO 9000, maturity development management and others. The crucial fields in quality assurance - planning of quality, configuration management, risk management, validation of product quality and verification of development process. Usage of standards (ANSI, IEEE etc.) in IS design. How to measure quality level implemented in an IS.

5.7 Program design (APP)

Methods for modeling the program support architecture (APP), concepts of DEV+ structure, relation between data model and program architecture, operations, design of approach to aggregation, examples of program architecture, planning of group processing in DEV data model, exercise. Presentation of completed application.

5.8 Development of prototype (PRO)

Development of prototype; Presentation of IS development tool; Presentation of information system; Follow-up of particular implementation of data base and program for updating and reporting supported by IV generation software (4GL); Presentation of prototype development; Basics of 4GL architecture; Data dictionary; Relational data base; Processes in 4GL; Implementation: processes with SQL, menus, tables, on-screen forms, reports, connecting relations; Practical example of building prototype on computer.

6. Success rate in training IS design

Success rate in training can be measured through a number of students that successfully completed training and passed the final exam, as shown in Table 4 and Figure 1.

Table 4: Number of students by years

Seminar	*Year*	Number of students	Successfully completed	Percentage of successfully completed (%)
NINA 1995	1995	19	8	42,1
MORH 1996 (21,6) PLIVA 1996 (24,14) NINA 1996 (16,11)	1996	61	31	50,8
HOO 1997	1997	30	17	56,6
HOO 1998	1998	8	5	62,5
HOO 1999/2000	1999	23	17	73,9
HOO 2000/2001	2000	10	6	60,0
HRT 2001	2001	8	8	100
MIRIS 2001	2002	10	6	60
Kraš 2003	2003	12	12	100
Total		**181**	**110**	

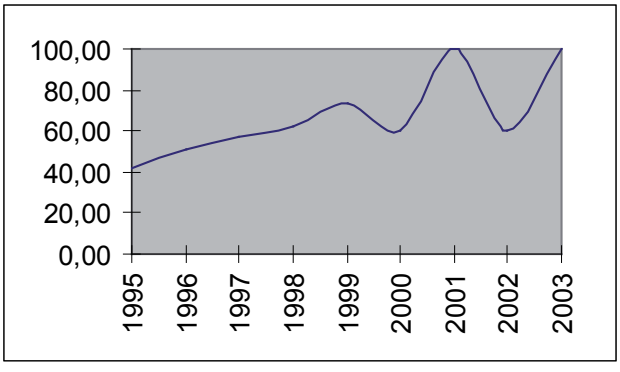

Figure 1. Percentage of graduated students by years

Seminars were sometimes attended by management or other persons on part-time basis without sitting for exams and these data, where known, are not included in the Table 4.

Success rate in training design could be measured more accurately applying the following criteria:

- Quick familiarization with business technology of organization system
- Quality of the project
- Quality of the developed IS program support

It is considered that teaching was improved over time, which confirms the percentage of students that completed their courses successfully.

6.1 Teaching as a communication process

During teaching, numerous misconceptions were noted. At early stage, results were poorer. Half of the students would not sit for exam or they would not pass the exam. A few students actually became IS designers.

There were quite a great number of students attending first seminars. At the time, a number of various methods for the same task were theoretically studied. The teaching was oriented towards the concepts of method structure. Modeling process was disregarded.

It was the teachers who defined and achieved aimed teaching goals. Students have showed quite a high degree of knowledge and enthusiasm. But something failed. The number of students that became designers was not as high as desired. Particularly efficient studying did not help so new methods, which would foster creativity, were searched /**11**/.

Teaching can be well elaborated, materials covering topics could be prepared, students could learn everything as planned, so we could speak of a good teaching. Yet, students are not able to independently design information systems, and the excellent teaching, produced poor results.

Over time, teaching has included knowledge from critical-communication didactic. It has been permanently aimed to improve the teaching. In teaching, democratization and humanization is the potential future horizon and any failure in teaching is seen in that light and used to acquire new useful knowledge.

Teaching is a communication process. There is interaction between teachers and students. Teaching starts, last and ends through an intensive communication.

Teacher is a moderator, who is, during teaching, permanently available for communication with students.

Any question to any direction establishes a relation of new quality and provides an opportunity for other students to learn. Such flashes of digression are the source of new ideas and they increase the power of designer's thinking - designers are born.

In communication, roles are changed, at times teacher assumes a designer's role, and at times he is a user. The same roles are assigned to students in their communication.

Teacher is a communication moderator and he does not allow ineffective communication (wasting time). This is students' role, too, and students are also entitled to join the communication. Person and his/her attitude are respected in communication.

From the communication process, teacher measures and reads expected teaching results (acquisition of designing skill), as shown in students statements, actions and decision referring to simulated reality. There is an active communication in order to present skill acquired during teaching, while if objectives are not achieved, teaching is intensified in order to reach necessary knowledge and obtain results, i.e. teach a designer. The objective of teaching is to teach students how to design, there is a confidence in students and, at last, difference between the expected and the modeled by students is analyzed, what results in assessment of the quality of a project solution and design speed.

The success of training is controlled immediately during the training. The control can be obvious or hidden, through feed back instructions, advices, desires, opinions, and answers. The control provides and enables the progress of teaching. Otherwise, the progress in not effective.

Noted features of the good teaching are:

- teachers should present concepts clearly and loudly, not too fast,
- he/she should communicate permanently, in all directions,
- student should actively contribute the teaching, even through "wrong" questions,
- initially, teacher should direct the teaching in the wrong direction and then search various solutions - he/she should not present the correct result at once,
- teaching should be supported by examples required by student, teacher should not used his own, selected examples,
- teacher should verify that topics presented are understood whenever possible,
- students should be given enough time for independent works.

The development of creative potentials in modeling information systems is related to the application of critical-communication didactic. Researches in making teaching models led to increased number of educated designers.

7. Conclusion

This paper presents experience in training designers of information system using various models and knowledge of didactic as a critical theory for teaching communication.

The MIRIS methodology has six phases of development of information system. Education model for the MIRIS methodology has ten defined seminars, of which three are practicing methods and one is practical software realization. 65 hours of teaching are required minimum for presenting defined topics.

Accelerated and abridged presentation of a particular topic can be redesigned as one-day or briefer course for providing information only, where students are not intended to acquire the design skills.

Improvements in teaching can be achieved through implementation of communication in teaching, in practical exercises as well in presentation of concepts of method structures. A better understanding of teaching enables higher degree of acquisition of knowledge, and eventually, making decision whether to sit at the designer exam or not.

This paper resulted from experience, on the basis of need for making the teaching inventive. Education of designers is a creative communication process.

Further research on effects of teaching could be made through establishing a method for measuring designing potentials after completed education, varying the teaching by sequence, examples, individual effects, effects in group, result relations and emotional moods (confidence and methods, attitudes, believes), measuring changes in attitudes and exploring teaching without and with various level of communication. It is quite clear to the authors that measurements in this field are especially aggravated and that initial states can considerably influence the results and conclusions.

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