INTRODUCTION TO DIDACTIC METAPROGRAMMING

UVOD U DIDAKTIČKO METAPROGRAMIRANJE

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Abstract

Preparing hypermedia didactic programs on the basis of the most modern solutions in the scope of information technology allows to create certain portions of information in form of multimedia messages depending upon the character and aim of the message. Moreover, the use of hypertext allows to combine particular modules in (major or minor) program blocks in such a way that it is not noticeable by a student to show their individual way of learning, what is significant for didactic metaprogramming. Despite the fact that it is, to some extent, algorithmisation of the didactic process, there is no dehumanising automation of the didactic system by replacing a teacher with a machine or program but it is about facilitating its aspects in which such form of education is needed and which is compliant with the current way of learning in the student environment.

Today, there is a necessity of didactic metaprogramming giving the possibility not only for multimedia presentation of the education content but also the interactive work of the student - allowing to be beyond the delivered information – use the considerable achievements of didactic programming in connection with dynamically developing information and communication technologies needed for teaching and learning at school and for the whole life.

Sažetak

Priprema hipermedijskih didaktičkih programa na osnovi najmodernijih rješenja u okviru informacijskih tehnologija, omogućava kreiranje određenih dijelova informacije u obliku multimedijske poruke ovisno o karakteru i cilj poruke. Štoviše, korištenje hiperteksta omogućuje kombiniranje pojedinih modula u veće ili manje programske blokove, na način da nije zamjetljiv pojedinom učeniku što je važno za didaktičko metaprogramiranje. Unatoč činjenici da je, u izvesnoj mjeri, algoritmiranje didaktičkog postupka, nema dehumanizacije automatizacije u didaktičkom sustavu, zamjenjujući učitelja strojem ili programom, ali olakšava njegove aspekte u kojima je takav oblik obrazovanja potreban i koji je usklađen sa sadašnjim načinom učenja u studentskom okruženju. Danas, postoji potreba za didaktičkim metaprogramiranjem dajući mogućnost ne samo za multimedijalne prezentacije i edukacijske sadržaje, već i interaktivni rad studenta - dopuštajući da se iza dostavljene informacije - koristie znatna dostignuća didaktike u programiranju, u vezi s dinamičnim razvitkom informacijske i komunikacijske tehnologije potrebne za podučavanje i učenje u školi i za cijeli život.

1. Didactic metaprogramming as hypermedia educational space

An information overload, commonly occurring in the curriculum, can become a good solution, from the student's needs and developmental capabilities point of view, only by the means of "intelligent" (hypermedia) computer didactic programs enabling a database search and an educational processes self-organization. It is in conformity with contemporary cognitive psychology, which rejects research methods originating from the human behavior research based on simple relations stimulus – reaction, due to the fact that it does not recognize simple cause and effect relations. It is assumed that the analysed systems have abilities of self-organization. Self-organizing („intelligent") educational programs can become peculiar "filters" in the modern world mass of information, they will allow to rationally organize "info-realm", which surrounds every man. In my opinion, there is a necessity for another analysis regarding a possibility of applying in didactics certain algorithms, export systems and methods of artificial intelligence to create hypertext educational programs.

Previous attempts to program educational processes led to their, smaller or greater, automation. While a present development of information and communication technologies creates a possibility to combine natural human "multimediality" with computer program multimediality and interactivity. It's worth mentioning here that gradual (since 1970s) introduction of audio-visual and, later,

multimedia educational means into educational processes led to their enhancement, at most. I have introduced the notion of *didactic metaprogramming* on account of the need to "go beyond" stiff and formed by the behaviouristic tradition ways of educational programming. In accordance to notional understanding of the prefix *meta-* which means: beyond, after, above, including, among, according to, indicates sequence or variability of something. It is accepted in informatics that *metaprogramming* – is a technique which allows a program to create or modify the codes of other programs (or their own) during their operation. Hence a didactic metaprogram is one that includes functions of all student and teacher programs, creating a consistent hypermedia educational space. It is possible thanks to the use of hypermedia.

2. Possibilities and limitations of hypermedia use in educational processes

Carried out analyses, regarding an evolution course of psychoeducational learning theories in relation to the development of information theories from the behaviourism through humanistic theories up to cognitive theories (cognitive-constructivist), indicate the need to comprehensively (complementary) encompass learning and teaching theories during the modelling of hypermedia educational programs (fig. 1). Nowadays, there are no evaluative questions asked regarding any theory, since the search for a homogeneous theory, without taking into a consideration multidimensionality of

human psyche is recognised as failure. Individual human psychological concepts accept one or some of dimensions of its essence. The search for optimal solutions in the scope of hypermedia educational programs modelling and optimization should be based on educational and methodological complementarities of individual conceptions and forms regarding the pedagogic conduct. It is justified by a variety of education aims and content as well as diversity of students' characteristics and experience.

Having analysed the conceptions which were the basis of educational systems reconstruction, it can be stated that behaviourism determined the range and possibilities of learning automation while humanism attributed a superior part to the conscious orientation of those processes towards the values believed in and aspired to by man (orientation to individual maturity), finally cognitivism brought in activeness and constructivism independence into processes of reality cognition.

The basic teacher's role is to control educational processes (in a didactic literature it is described as management). Describing a teacher's role as a subject that manages a student is not aimed, from the information theories point of view, at determining the possibilities of their physical elimination from the system and replacing by a machine (computer), but it serves a purpose of better explaining those process mechanisms and a considerable broadening teacher's possibilities that is, those situations, events (and their parameters), which can be influenced in some ways. The point is, to recognize possibilities of
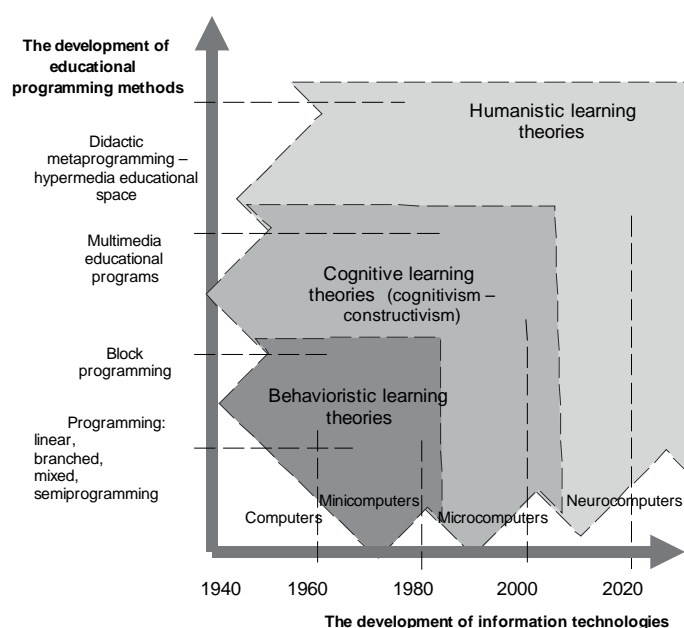

Fig. 1. The development of psychological and pedagogic learning conceptions in the context of the development of educational programming methods and information technologies (own study).

educational processes optimization from the point of view of information theories and practical use of computers in specific educational situations.

Hypermedia didactic programs (HDP) is a new group of educational studies which, thanks to including messages based on different media, create a homogenous educational message, and their implementation has an interactive character. That is why a necessity arises to explain the *difference between hypermedia educational compilation and traditional compilation published in form of book?* The basic difference is that in hypermedia didactic systems every part of it is performed by a hypertext program, apart from that thanks to its interactivity, the emphasis is put on student's independent work. Those programs have many functions in educational processes which can be reduced to three main ones: cognitive-educational, emotional-motivating, operation-interactive

The methodology of HDP planning and optimizing is a phase process, where five main steps can be distinguished: defining the program aim and requirements, designing – preparing the schedule, execution – program creation, testing – trial version tests, use and modification – permanent improvement of the final version of the program. It is also possible to precisely determine the aims which can be achieved by the program.

The multitude of educational situations where the program can be used not only as educational means to improve lessons, but often as a way to regulate their course – as a peculiar means-method, will indicate its didactic value. This will also show those programs uniqueness. There is an urgent need to explain their influence on the modification of student and teacher activity systems, it can be said that they are the basis for a separate didactic strategy within the hypermedia education.

The didactic programming in the previous approach was limited to a creation of more or less developed „stiff" didactic programs: linear, branched and mixed. Only block programming (block-problem) and semi-programming have shown some possibilities to move away from education automation. At present, a new impulse for didactic programming comes from the research on artificial intelligence and neuronal webs. I think that there are two ways to use AI. One of them is a creation of computer educational programs with, so called, friendly interface that is, orientated to user's needs and capabilities, where the knowledge of a complicated code is not required. The other way to use AI, is the education individualisation. Multilevel didactic programs (including many „paths of learning") adapt „themselves" to the user's level of knowledge and abilities directing him

from one educational level to another. The scope of knowledge a student already has is then avoided in favour of things he/she still has to learn. After an initial control and evaluation of the candidate's knowledge level he/she is directed on the right (individual) "path of learning". During this time the system tests student's knowledge and abilities in order to improve his/her individual learning model, determines the improvement and chooses the next learning path. In order to achieve that there can be established a *set of fuzzy rules*, which will combine tests results from a suitable decision determining and modelling student's individual learning path.

I would like to emphasize here a crucial role of the teacher as a „guide standing by", often directing a student and constantly modifying the program, giving to a student a sense of achievement (subjectivity and responsibility for actions).

3. Methodology of designing hypermedia didactic programs

Scientific research results shall be also reflected in practice. The main task is to prepare a procedure of designing hypermedia didactic programmes. Firstly, there should be defined the main didactic aims for which the prepared project is vital, then there is the didactic analysis, characteristics of the psychophysical development of students (recipients of HDP), preparing the tools of preliminary control, preparing the strategy of teaching and the proper designing and performing the didactic program (HDP in this case). The procedure shall be finished with preparing the tools for measuring the current (forming) control and collecting (summary) control.

While designing the structure of the HDP content – the general structure of multimedia books may by applied (W. Walat 2004, p.196), which consists of such components-blocks as: informative, exercising and controlling, organising and managing, and synthesising. Forming the principles of constructing the aforementioned blocks, I used the methods applied in general and detailed didactics. However, I showed their use in the new situation when we may apply within a vast range of informatics technologies (hardware level) and information technologies (level of information processing methods). Designing information blocks HDP becomes easy when we use the matrix analysis of a text and the graph theory. The highlighted notions and key relations for a given fragment of a text composes a network of the hypertext performed in a given program. Previously applied, laborious calculation methods, nowadays (thanks to information technologies) have led to the preparation within a relatively short time as well as a transparent structure of a text (hypertext). In the

next stage, there is only the expansion of this notion network by such components as: illustrations, simulations, case studies, completing and expanding texts. The attempt to answer the question: not only – what to teach at a given education level ? but also – how to teach optimally ? is a key factor for seeking the theories of structuring the content of education formed for the benefit of programmed education (known as theories of operative structuring). Educationists, interested in these methods, aimed their research powers at performing the diligent analysis of the education content, in particular, consisting in the contents of the messages and their relations. Here, there are used the methods of so called graphs and didactic matrix or graphical seminology.

In case of exercising and controlling blocks, the key actions while designing HDP is to prepare logical sequences of sentences which are the matrix of the didactic situations organised by a teacher (didactic and educational) situations as well as the control tasks allowing for getting familiar with the course of the didactic process and make a decision on repeating any of the information modes or entering further and higher levels of education. The scope of performing didactic processes approached as a system, requires designing the sequences of didactic tasks (approached as certain cycles of a characteristic for a given field of education), repeated at particular stages of education (primary school, middle school and secondary school and higher). As a result, the actions taken by students – primarily single isolated actions – gradually become the actions which has been formed to be more complicated sequences. Then there are system features of the cognitive activity developed by students. There can be assumed that the proposed model of the methodological level of media education encompasses the mechanisms increasing the self-management of man, learning the attitudes in a dynamically changeable, informaticised life environment. Thanks to connecting the didactic tasks in sequences there is a possibility of multi-stimulant differentiation in the educational influence of the teacher on students as well as functional direction of the education process. Organising and managing as well as synthesizing block is mainly an external expression of the assumed structure of the HDP content. In this context it can be assumed that its form whether it is a set of expression means applied for the most appropriate way of passing information included in a given hypermedia message. While designing this structure, the following principles introduced from the education psychology laws shall be applied: concentration, activation of the students, structuring of the content. The blocks may

encompass any kinds of dictionaries, glossaries, references and mostly easy to use menu (functioning as a main list of contents). The analysis of the applied in HDP designing solutions of organising and managing and synthesizing blocks may allow to formulate two basic conclusions. The first one regards the fact that any formal solutions allow for performing didactic and cultural functions which are defined by the author of the book. The second one regards the greater possibilities of increasing the motivation for teaching and actions which are well-organised and clear due to the hypermedia form while didactic studies. In HDP modelling, the structure of its form is important. The selection of media, mostly presenting ones and expanding HDP raises many doubts. The basic criterion of selecting the presenting media is its dependence on the aim of presenting the education material and its kind including: availability, handiness, mobility, calibrateability; equipment and material quality (slides, foils, books, charts, pictures, computer data, video cassettes etc.); effectiveness of information transfer – usefulness for a given picture form (lesson with a show, lesson with practical training of the students in a computer room etc.).

Conclusion

Well functioning computer rooms with Internet access is reality and there is the newest audio-visual equipment in given computer rooms : video, computers, overhead projectors, allowing for having lessons with many various HDP for students and teachers. These devices enrich lessons, however, there are some drawbacks: the more technically advanced, the greater distance between the teacher and students. That is why it is time to implement the solutions in the scope of ICAI (*intelligent computer assisted instruction*).

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