Computerized Support in Decision-Making Processes in Israeli schools.¹

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Abstract

The article describes difficulties arises using information in Decision Making Processes (DMP) . Then analyzes the computerized support in the DMP and describes the Expert System "MATANA" that supports the learning management processes at school. "MATANA" has been tried in several schools.

The main findings of a follow up study were:

- * The use of "MATANA" helped the principal to manage the laerning system, while broadening his cognitive abilities.

- * The system created a more objective base for the learning management detached from inter presonal relationship.

Key word codes : I . 2 . 1 ; K . 3 . 1

Key words : Applications and Expert Systems ; Computer uses in education.

1. INTRODUCTION

The true test of the teaching quality is in the development and incorporation of learning processes which lead to learning achievements. The conversion of teaching processes into learning processes is accomplished mainly by developing group processes, which generate learning activities in each of their members ,which act as a group of learning units [2].

This situation necessitates proper *learning management processes* aimed at directing and establishing learning. The processes exist on two levels: learning management by the teacher in the classroom and learning management by the school principal and the subject coordinators on the group level [8]. In this paper we will focus on the group level.

Organization systems, including schools, are characterized by a high degree of complexity which is directed by decision- making of office holders within the system. The school principal and subject coordinators exert strong innuence on the nature of school functioning and its production, and on the nature of teaching-learning processes and learning achievements, by action or by default.

¹ The study was carried out within the framework of the author's doctoral thesis, under the supervision of Prof. D. Chen.

However various problems within two groups of factors cause difficulties to the school principal in carrying out his job. The first group of factors is conceptual and comprises task perception, aims of learning achievement assessment, etc. The second group includes a list of practical difficulties relating to information use and cognitive difficulties connected with decision-making processes. Both groups of difficulties exist within a closed circuit; the elimination of one of its elements enables a breakthrough. The conceptual element cannot be dealt with so long as the practical element exists. However, a change in the practical-cognitive element has become possible with the potential that information technology now offers. Our paper will focus on the description of the difficulties and the specification of this potential. We will then describe the contribution, both theoretical and actual, of the expert system "MATANA" and its influence on the learning management system in schools [7]

2. DIFFICULTIES IN USING INFORMATION LEADING TO DECISION MAKING

Difficulties arising between user and information develop in three "environments" or groups of factors which interact:

- * Difficulties connected with the cognitive process.
- * Difficulties originating in the nature of decision-making situations.
- * Difficulties developing in decision-making processes, which include practical difficulties in dealing with information.

2.1 The cognitive process and decision-making

Psychological research has dealt with the nature of the cognitive element which forms the nature of human decision-making [1]. Limitations of the cognitive process can be caused by a number of factors:

- * Selective perception, developing from various conceptual frameworks this is uniquely self-strengthening.
- * Limitations of human thought, due to variations in cognitive abilities and connecting to different styles of thinking.
- * Motivational tendencies, such as defensiveness which reinforce selective perception on an additional plane.
- * Limitations of human memory which hinder development of an interactive process between consciousness and memory.

These and other limitations may result in a person acting in a "perceptual environment" rather than in a real one. The main question is: *whether the "perceptive environment" can be made into a representative sample of the real environment and how this may be done best.*

2.2 Difficulties arising from the nature of decision-making situations.

The nature of decisions depends on the nature of the decision-making situations. They exist on different levels on a continuum which stretches from certainty (almost complete) to great uncertainty. Four phases may be observed [10]:

I Deterministic situations, clearly structured and well defined. Decision-making rules and/or an algorithm of the decision-making process may be determined in advance, leading to "automatic" and clearly structured decisions.

II Probability situations. These situations are not clearly structured, but by acting in accordance with well-known and accepted rules of probability they "become" deterministic and well structured.

III Deterministic and partly structured situations. These situations partly resemble those mentioned under (I) and partly those under (IV), below.

IV Heuristic decision-making situations not clearly structured or defined in any way. These situations produce heuristic decisions based on intelligent guesses which are founded on the wisdom of accumulative experience.

Decisions in organizational systems, decisions relating to the management of a learning system by the principal, for example, usually occur in heuristic decision-making situations with a great degree of uncertainty [1]. Here the principal relies on basic suppositions and projected intelligence designs, which are at times incorporated and uncontrolled. He relies on his intuition without having sufficient information and tools for its analytic substantiation. Finally he creates for himself, by a spiral and interactive process, a partial and biased "perceptual environment".

2.3 Difficulties in using information in the decision-making processes.

The decision-making process may be divided into two main elements, descriptive and inferential.

The first includes: data collection and data processing; while the second consists on information interpretation and decision-making.

Five types of practical difficulties relating to information use arise in this context [8]:

- * Difficulties in *encompassing all the data* in the system.
- * Inability to *process* data and prepare a *wide variety of reports* as required.
- * Problems relating to the *quality of information* which is determined by the extent of its being up to date, complete, precise, relevant.
- * Difficulties in *controlling information*, relating to its selective availability.
- * Difficulties in *information analysis and interpretation*.

Routine treatment of the problem by means of computerized information systems like MANBASS² (Israel) SIMS (England) etc., [7] solves the two first types of difficulties completely and provides partial solutions to the third. However, an extended study of principals using MANBASS has indicated increasing difficulties in the control of information as the user is flooded with new information. There are also significant difficulties in analysis and interpretation of information which derive from difficulty in control as well as from the user's partial knowledge in the sphere of methodic pedagogy.

Thus has prompted me to develop an Expert System (ES) support decision-making as it relates to the management of the learning system in the school [3], [4]

3: "MATANA" AS A LEARNING MANAGEMENT SYSTEM (LMSS).

3.1 Broadening cognitive abilities [9]

Just as the technology of materials and energy can broaden physical man's abilities so

² "MANBAS" - a Hebrew acronym for a computerized information system, operating within the schools in Israel.

the information technology can broaden his cognitive abilities, as mentioned above. Transaction Processing Systems (TPS) help in overcoming the two practical types of difficulties mentioned above as well as part of the third one, but it does not handle other types of problems. In contrast, Expert Systems (ES) treats complex existing problems which require expert interpretation [5]. These systems comprise, in addition to routine elements of information processing (data base and processing and organization mechanisms), a knowledge base, inference engine and an interactive interface for the user [1]. Expert systems supporting decision-making processes are in fact a combination of ES and DSS (Decision Support Systems) and are called EDSS.

Generally speaking, EDSS brings the decision-making ability of human experts in the field, or on specific subjects, together with their limitations in ability to foresee all anticipated events, and/or their complexity. Experts offer a number of capabilities:

- * Thinking at various high cognitive levels.
- * Infrastructure of well reasoned and appropriate basic assumptions.
- * Comprehensive, profound and specific knowledge of the field.
- * Guidance in the use of data and information.
- * Suitable decision-making frameworks for use in various situations.

These capabilities, together with the system's ability those of inference, analysis and reasoning constitute the possible contribution to the everyday user in a number of spheres:

3.1.1. : The system puts new and improved cognitive tools and perceptual means at the users disposal and these create an *infrastructure and network of decision-making frameworks*, which allow reliance on *the cognitive modes of the human expert*.

3.1.2. : The system provides the user with *knowledge in specific fields* of expertise thus enabling development of consulting processes with experts. The knowledge presented and the ways in which it may be used *will fill the decision-making frameworks* previously built in a *general context and which will include "a code of behavior" of the various factors involved*.

3.1.3: The system will assist in proper use of information by structured separation of the descriptive from the inferential elements. First, *a selective examination of relevant data and selective operation of the processed data for the presentation of information relevant to the situation being researched* will take place. Later, with the assistance of the knowledge base and the inferring mechanism, the system will present an *examination of alternative interpretations of the context revealed with an emphasis on the preferable interpretation of the situation studied*.

In summary, the system supports all the spheres of difficulties described above and which develop in heuristic decision-making situations, for instance a learning management system. Against the background of the "general context" and the infrastructure of decision-making frameworks mentioned above, a context specific to the studied situation emerges thus allowing the formulation of *"a perceptive environment" which is more objective, rational and well-founded*.

The responsibility and superiority of the human factor in this process should be mentioned here. The intelligent user will reflect these by *pedagogical consideration* based on his knowledge which is either intuitive or partially substantiated and which will include nuances known only to him. This "knowledge" will induce a *fertile confrontation* with "a second opinion" that of the expert, [6].

3.2 : "MATANA", a general description

The purpose of the following description is to provide a general presentation of the system³

The option menu will follow the introductory screen [9]:

<p><u>A learning management support system</u></p> <p><u>Expert operation - option menu</u></p> <p>A. General survey of school</p> <ol style="list-style-type: none"> 1. General examination of all classes in all subjects. 2. The abovementioned examination according to groups of classes. 3. General examination of subjects. <p>B. In-depth examination</p> <ol style="list-style-type: none"> 4. Class examination. 5. Examination of subject according to group of classes/streams. 6. Teacher examination. <p>C. Analysis of quality of teaching</p> <ol style="list-style-type: none"> 7. Examination of teachers' and other factor activities in specific classes. 	<p>For previous screen press esc</p> <p>To continue press number</p>
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The option menu demonstrates the system's three stages:

* In the first stage the system surveys the students' achievements⁴ in order to locate irregular learning situations in the school, or in various sectors, as described above.

* In the second stage the system focuses on the sector identified as a location of irregular learning situations, or one that has previously been recognized as such, and conducts in-depth examinations of three possibilities, according to the user's choice.

* The third stage is different from the previous two. Here the system analyzes the teaching situation qualitatively and not quantitatively as before. The user will collect data and enter it into the system as an answer to the computerized questionnaire.

In each of the examinations of the first stages (A,B) the system provides three outputs:

* A summarizing table of failure occurrence in the tested sector, for example, the percent of failure in mathematics at school, according to three levels (as determined in advance by the user).

* A table specifying failure occurrence in mathematics, according to teachers and classes in one of the group of classes, according to the user's choice.

³ A more detailed account may be found in (8).

⁴ The students' achievements, in each of the tests were determined by the grades obtained in tests conducted over the year or at the end of the trimester / semester, according to the user's choice.

* Verbal findings that provide a description of the location and characteristics of the problem, and finally the conclusions and recommendations derived from the specific case.

The system examines various characteristics of irregular learning situations. For example: Does the problem arise in one or more classrooms, Is it characteristic of one particular teacher and various students in the class, or does it exist among several teachers with the same students? In addition, a test of various statistical indices is conducted; for example, the nature of grade distribution and average grade. The combination of the examination results contributes to the system's recommendations, based on expert opinion which is built into the system in a series of logical rules, of the form "if...then...".

The third stage (C) analyzes the quality of teaching. It is here that the system examines the *nature of learning program implementation as carried out by specific teachers in a given class*. The groups of factors examined here are:

- * learning organization and planning
- * teaching and development of learning operation
- * the learning environment
- * classroom climate and physical factors
- * teacher-student relationship
- * class management by the teacher

The user examines the teaching performance of a specific teacher several times in different classes, or that of several teachers in a specific class, teaching performance of several teachers in one specific subject, or in different groups of classes. The system weights the average of the examination results and presents the characteristic findings of teachers, classes and subjects. These serve as a basis for future pedagogical instruction.

3.3 Use of "MATANA" and its effects

"MATANA" has been tried out in several schools and a follow-up study of its use in the system has been carried out. Its effect on school principals was tested in comparison with the effect of MANBASS.

Below are some of the findings:

- * The principals' opinion is that both control and quality of information are improved when using "MATANA", as a result of the selective availability of required information.
- * The principals found that the system adequately supports the analysis of information, as the decisions rely on well-founded and practical information.
- * Use of "MATANA" resulted in the transfer to the principal of initiative for system control and in the development of routine examination during the school year.
- * Guidance provided by the system directed principals to broaden and diversify decision-making subjects. Along with decisions regarding students, decisions were reached regarding level of teaching, suitability of syllabus, teacher behavior, etc.
- * The principals' opinion was that the system creates a more objective basis for the management of the learning system and is independent of interpersonal relationships, leading to "more persuasive" results.
- * Teachers in need of guidance were identified and in some cases guidance was provided.

- * However, feelings in the teachers room were mixed. Despite the advantages, the teachers felt more threatened than they did after using MANBASS.

To complete the picture we will present the system's two main limitations and give appropriate recommendations:

- * The set of rules is limited a priori as a result of the impossibility of foreseeing all irregular situations. In order to overcome this limitation we would recommend to continue the development of the knowledge base, while taking into account the users' remarks and the knowledge gained by cumulative experience.
- * There is a danger that the user will be subject to "idleness" vis. a vis the system; this will result in him not using his reasoning powers and there will be no fertile confrontation as described above. Experience proves that appropriate guidance may be helpful in this matter.

Guidance and gradual operation are mandatory for good implementation and correct operation of "MATANA".

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