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EVALUATION OF THE ENVIRONMENT FOR EDUCATION IN MULTIMEDIA-BASED SYSTEMS USING SEVERAL MEDICAL INDICATORS, INCLUDING P300 FOR EVENT-RELATED POTENTIALS

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ABSTRACTS

The construction of computer-based systems went the furthest in providing a supportive environment for teachers to create educational programs in the university and the social education areas. The authors introduced a cluster system configuration for educating, called Circular Sociogram Structuring, which provides machine-arrangements for easily producing high-quality communications among students. A major objective of this structure is to produce educational environments of better quality as measured by neurophysiological and psychosomatic indicators.

The ultimate goal is a school, office and life environment which offers a range of highly motivating activities for increasing good neurophysiological- and psychosomatic effects. The authors provide a new method to evaluate environments for education in multimedia based-systems using medical indicators, including P300 and the others for event-related potential, and pupil-dilation response to various stimulations in the educational environment.

INTRODUCTION

The Stanford project developed and tested nationwide systems for arithmetic and reading in the mid- to late-1960s (Suppes[1], 1966; Atkinson & Wilson[2]; 1969). However, none of these efforts at CAI were widely adopted (Bitzer & Skaperdas[3]; 1970). One of

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the major factors for the lack of acceptance was cost. There was a second major problem with drill and practice approaches, keeping students motivated and avoiding frustration. In the late 1960s, at the time that the "free-school" movement was at its height, Papert and others at MIT started the LOGO Project. The LOGO approach viewed both learning to program and the acquisition of subject matter as important aspects of computer based activities.

The construction and activities of computer-based systems should be designed so that students have as much support as necessary (especially at the initial stages), but also have the ability to go beyond that support. Careful attention to the classroom space, including the arrangement of machines and control of the environment, can help keep students motivated and avoid frustration. An adult expert can play an important role in providing dynamic support, both by suggesting new goals within an activity and by suggesting (or simply making available) new activities (Hidaka et al.[4]; 1997).

Computers should be arranged so as to enable and encourage peer interaction and help. Educational computer environments and activities should be designed so that they enable the students to gain in expertise as they further engage in those activities. The role of motivation in bringing about learning cannot be overestimated. Students can be forced to engage in activities they do not like, but unmotivated or frustrated students are unlikely to achieve the intended goals of the activity. Educators are well aware of the need for motivating activities; once educational goals are set, much effort is developed to the question of how to design motivating activities to achieve these goals (Levin & Kareev[5]; 1980).

In this paper, the authors will describe some of our new methods to evaluate environments for computer-education using several medical indicators, including P300 for event-related potentials (Barrett, G. et al.[5]; 1987). Then the authors will outline a range of indicators available with proposed methods, both to explore possible medical indicators for evaluating of environments and to gain some insight as to why new methods should be used for evaluating.

ENVIRONMENTS FOR MENTAL AND CREATIVE ACTIVITIES IN SCHOOL, OFFICE AND HOME

The authors have seen how computers have become an integral part of most schools today. As software is improved and new application software programs or new releases of old standbys are developed, it's pretty safe to assume that making computers our school and business partners is a wise decision (Hidaka et al.[4]; 1997). In order to produce the best results for the mental and creative activities in school, office and home work, integrated school, office and home systems, designed to assist in human intellectual activities, should be used to create an environment that motivates the mental and creative activities when needed at all times.

School and business environments are a sociometric structure made of different levels of educational and working effects, such as the arrangement and the communication, shown in a plan for our computer-assisted instruction system started by Hidaka et al. (Project) in 1992, supported by a Grant-in-Aid for Information Education from the Ministry of Education, Science, Sports, and Culture of Japan in 1992. The total computer system configuration, called Circular Sociogram Structure, began its arrangement for the first time as shown in Fig. 1.

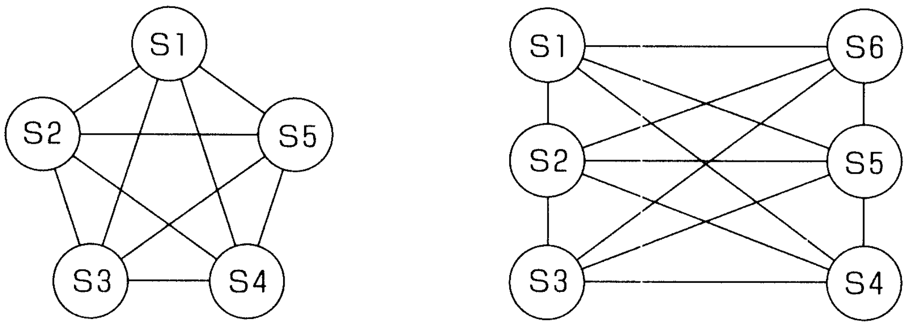

Figure 1. The cluster system configuration for educating, called Circular Sociogram Structure, providing instrument arrangement for easily producing high-quality communications among students (S1～S6).

In order to use the computer system as effectively as possible, it is important that educators and users (students) interact with each other while respecting their own roles. Systems have been made available by which communication is activated among students. The usefulness of our computer system was greatly advanced by the circular sociogram structure and the function of a system of personal computer LAN (Local Area Network). Our computer system is an educational system for providing tools to produce high-quality education. This environment for education in information technology is being provided students so that they will be motivated to study computer technology useful for their future work. What are the educational implications of this dynamic support hypothesis for structuring computer learning environments?

DESIGNING A MORE CREATIVE COMPUTER EDUCATION ENVIRONMENT, AND ITS NEUROPHYSIOLOGICAL AND PSYCHOSOMATIC EVALUATION

Students were allowed to work by themselves or to choose a friend with whom to work during their turns. Pairs of student working together substantially reduced the number of problems encountered requiring outside help. When student worked in pairs, a large percentage of the low-level problems encountered by one student were immediately solved by the other. Moreover, students working in pairs were able to divide up the work among themselves thereby dealing with the complexities of new situations in an efficient way (Hidaka et al.[4]; 1997).

The authors observed a recurring progression in the way students engaged in computer activities during the classes for our educational subjects. Student “experts” emerged for different computer activities. The student who had learned a simple task would often increase the level of complexity of the tasks attempted. The progression from low-level to expert-level performance occurred almost every time we introduced a new computer activity to the class. Once a student became proficient at a particular activity, other students would turn to her for help rather than call a teacher. Since there were a relatively large number of activities, expertise was widely distributed among students (Hidaka et al.[4]; 1997).

Our observations suggested that computer activities, when properly organized, lead to a considerable increase in cooperative peer interaction, more so than almost any other classroom learning environment. Students gained in computer skills and self-confidence. Students became motivated to achieve at intended tasks. Students were able to gain competence since they became motivated and enjoyed their assigned tasks. Unmotivated and frustrated students could not have achieved educational goals so well.

As educators, we are well aware of the need for motivating activities. We know that our students are unlikely to learn from being forced to perform activities they do not like. We were able to design computer activities which enabled the students to gain expertise, remain engaged, and master their subjects. The authors introduced a cluster system configuration for educating, called Circular Sociogram Structure, providing machine arrangements for easily producing high-quality communications among students. A major objective of this structure is to produce educational environments of better quality.

The ultimate goal is a school, office and life environment which offers a range of highly motivating activities for increasing neurophysiological- and psychosomatic effects. The authors provide a new method to evaluate environments using medical indicators, including P300 and the others for event-related potential, and pupil-dilation response to various stimulations in the educational environment (Table 1.).

Table 1. Experimental Contents and Procedures for Evaluation of Environment for Education in Multimedia-Based Systems Using Medical Indicators, Including P300 and Others for Event-Related Potential, Pupil-Dilation, Electroencephalograph and Heartbeat of the students for the Various Stimulations in the Educational Environment.

Test-Contents (Evalu. Indicator)	Measurement Instruments* (Evaluate Instrument)	Activators(Stimu. and Environ. Evaluated)	Refer.***
Electroencephalography (EEG)	Electroencephalograph	Somato. Evoked. Poten. Electro./Somato.	1.2
Heartbeat	Heartbeat Instrument		3
Pupil-Dilation	Pupil-Dilation Inst.	Visual Stimulation Flash/Image	4
P300-Potential	→	Auditory Stimu. Sound/Music	5.6
N400-Potential	→ Evoked-Poten. Inst. Sound • Light Stim. Inst.		7
Contigen Negative Poten.	→	Event-Relat. Stimu Recog./Language	8
Memory-Related Potential	→	Human-Group Stimu. Arenge./Comunica.	9

*) Measurement data are processed using a bioinformation-analytic program software on a personal-computer.
**) These activators and environments are used for evoking specific electric signals.
***) These references are reference for usage of each instrument in experiments.
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