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ABSTRACT

In order to obtain student feedback in computer programing courses at Duke University, a computer-based anonymous audience response system was used. This system consisted of a minicomputer, voting consoles, and a large electronic display. Students set their voting consoles in response to the question and the minicomputer interrogated the consoles. The cumulative responses in each category were flashed on an electronic display board to provide immediate feedback. The objective of the project was to acquaint the students with a unique application of the computers. The system was well-received by the students and proved to be very effective as a feedback device in promoting free and open dialog. (Author/DS)

EXPERIMENTS WITH A COMPUTERIZED RESPONSE SYSTEM: A FAVORABLE EXPERIENCE

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ABSTRACT

Computers have made a great impact on the level and technique of conducting courses in the engineering curricula throughout the country. Same phenomenon is observed in our daily lives. Our bills are processed via computers, our votes in national elections are tallied electronically, and projected using computers. Every facet of our social life is greatly affected by the massive amount of information generated by the computers. It is only natural to observe the welcome infiltration of computers in the academics.

This paper deals with the use of a computer-based anonymous audience response system for obtaining student feedback in computer programming courses taught by the author at Duke University. The system basically consists of a minicomputer, a string of voting consoles and a large electronic display. Typically, a question is posed to the participants and response alternatives are formulated with an input from the class. Students set their voting consoles appropriately in response to the question posed and the minicomputer interrogates these consoles. The cumulative responses in each category are flashed on the electronic display board to provide immediate feedback.

INTRODUCTION

In education, computers have been used very effectively. The most widespread impact of computer has been in the curriculum. Nowadays it is not unusual to find computer instruction even at high school level. Of course, at the college level one finds an abundance of computer programming and computer-oriented courses in many fields, such as engineering, physics, chemistry, mathematics, psychology, and business administration. The courses in these disciplines have been revamped to enable the student to concentrate his attention on the formulation of problems relating to real world situations. Having the accessibility of the computer the instructor can assign more meaningful and conceptually difficult problems. The computers do not have the capability of thinking for the student. However, they can classify and correlate the input by known and routine methods and extract the conclusions inherent in the source information.

Computers have also been used directly into the instructional process although they have not found a very broad usage. Thus far, they have mostly remained a subject of research and testing, with limited application. Of course, as the hardware and software costs decline this phase of activity may become more popular. At the present time there does not seem to exist a great deal of interest in the development and distribution of quality software to support computer applications in instruction on the part of educators.

A Delphi study [1]* was conducted to ascertain the causes for this trend in the area of computer-aided-instruction. In this study, questions posed to the panel of experts dealt with three aspects of the problem. These related to a) improvement in the educational process with the use of computers, b) reasons for computers not being more widely used in the instructional process, and c) actions to be taken to more fully tap the potential contribution of computers to the instructional process.

The group was in agreement over the first issue in that a proper use of computers in instruction would make education more productive and more effective, allow for greater individualization, and provide for greater equality of educational opportunity. The panel of experts participating in the Delphi study, on the second issue, identified six major areas of concern. These included production and distribution of instructional material, demonstration, theory of instruction, educational system, cost, and technical research and development.

Several action statements were proposed to enhance the use of computers for instrcutions in a follow-up conference. Some of these recommendations were to concentrate on the development of efforts involving problem solving exercises, educationally oriented computer terminals theories of learning and experimental data, and setting up of demonstration projects in model schools and towns.

One of the factors identified in the study was the importance of feedback. It was felt that by providing more immediate feedback

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* Numbers in square brackets designate References at the end of the paper.

the use of computers in instruction might provide efficient learning and perhaps, highly motivate students. The role of feedback in other areas such as citizen input and feedback in policymaking has been already recognized [2-10]. It has been shown that integration of citizen feedback into the policy and decisionmaking process would result in an across-the-board representation of affected parties at all stages of policy planning and development. The next consideration is to obtain and implement the feedback in a classroom environment.

IMPORTANCE OF FEEDBACK

Conventionally, the flow of information is unidirectional. For example, any speeches made by politicians and carried by television reach millions of masses. There is no built in mechanism in the media to provide feedback response. Although one can write back letters tc respond to the questions raised by the speech, it is by no means the most efficient method. In addition, if at all, it is made use of by a very small minority of the citizenry.

There exists a parallel in a classroom situation. The teacher gives a lecture to the class which is listened to by the students. Some of the students may be alert, attentive, and ready to ask questions. Others may be interested in asking questions, but may not speak out for the fear of being considered ignorant or inarticulate by their peers. A few students in the class may be simply interested in talking and hearing themselves talk with no

regard or considerations for others. A large segment of the class, normally falls in the 'silent majority' category. It is extremely difficult to get the reaction and participation of this group to the material presented by traditional means.

Examinations and quizzes serve the purpose of providing feedback to the instructor. Many times, this may be too late from the point of view of both the instructor and the student. An ideal situation for the instructor would be to obtain feedback from the students while he is lecturing to get an indication if the students find the material too easy, too difficult, stimulating, boring, dull, etc. Ordinarily, the instructor can obtain the consensus on the material presented periodically via a paper questionnaire. This can be too time consuming, however. Better means are needed to ascertain the feelings and perception of the students in classroom situation.

FEEDBACK DEVICE

An electronic feedback device utilizing present day computer and communication technology provides a possible answer. The device henceforth designated the Anonymous Audience Response System* (AARS) can provide the participants the capability of discussion and making comments (anonymously if so desired) on the information presented. The students can make their opinions known, quickly and conveniently, to the instructor. Each student has available to himself an independent channel of communication linked to an electronic digital minicomputer. The teacher may ask questions

* Available from group/dialog systems, Arlington, Mass.

regarding factors such as the complexity, pace, content, and quality of the course and the students may respond via the Voting Channels. These responses may be collected by the computer and displayed to the students as feeling indicators of the entire group. Anonymity feature may be vital in those cases where the students may find a topic or lecture particularly boring and may not wish to say so vocally for the fear of recognition.

The AARS consists of ninety individually hand-held ten-position rotary switch consoles. Each console has a window through which only one digit is visible at one time. The consoles are all wired for attachment to a central monitor with logic capabilities. An electronic columnar display consisting of 2 inch high tubes for numerals can exhibit all ten categories and their vote counts simultaneously. An auxiliary display can exhibit votes, category by category, by rotating a switch, located on the main console, through various options. The system has an update feature whereby the voting and display are set up in a continuous mode. Instructor can observe the feedback display and modify his presentation in response to student reaction regarding pace such as "go faster", "go slower," "about right", or dealing with any other attribute such as quality of presentation, for example, "excellent", "good", "fair", "poor", "terrible".

FEEDBACK METHODOLOGY

While the feedback sessions may take various forms, in a typical classroom environment, the teacher may pose a question to

the students by writing it on the blackboard or using an overhead transparency projector. Also, he may describe a set of alternatives ranging anywhere from two to ten, and coded with numerals 0 to 9 from which each student is to select the most appropriate one according to his way of thinking. Response categories such as "I don't know", "I object to the question", "I wish to make a verbal response", are also acceptable. Some of the candidate response categories may be generated as inputs from the students.

After the students have had time to understand and possibly discuss the question, the teacher explains the methodology for response, and provides any clarification required by the group. The response procedure consists of simply positioning the hand-held switch dial on the appropriate vote category. This can be done privately, since the switch dial is located in a recessed window, hence obscured from the view of the next student. After everyone had a chance to make a choice on the response alternative, the teacher presses the "vote" button on the minicomputer console. The votes in each category are totalled and displayed to the whole class. The next step is dependent on the response profile. The class may wish to discuss the significance of votes in each category or the persons who are in the minority on an issue may wish to make comments to support their views. A revote may be taken to see if verbal presentations made any change in voting choice of individuals.

This procedure may continue until a concensus is obtained, or the students may wish to go on to the next question. Fig. 1 shows a typical set up for obtaining the feedback in a classroom environment.

EXPERIMENTS WITH THE FEEDBACK SYSTEM:

Several experiments were conducted with different student groups in three courses, namely ME 31: Engineering Applications of Digital Computers, E 31: Computers in Engineering, and E 174: Technology Assessment and Social Choice during the academic years 1973-74, and 1974-75. In the computer programming course, the objective was to obtain student reaction to computers and an assessment of their assets or liabilities. Questions were also asked to obtain feedback on the course itself. It appeared from the class response that more than half of the the class had the learning of computer programming as its primary objective. Over one-third thought that getting a passing grade and having a good time were also important along with a learning of computer programming. When asked: what was of secondary importance, grades were stressed. In response to other questions, it was found that students liked the instruction and pace of the course, and the motivation was high.

On the questions relating to computer itself, two-thirds of the class felt that the computers in general were slaves (or tools) while one-fifth of the class saw them as merely giant brains. Two students felt overpowered or threatened by computers. Fig. 2 (a) shows, for example, the response categories and votes from the transparancy used for this question. The last three categories in this figure were volunteered by the students for addition to the list.

In another class the students were asked their initial reaction to the process of obtaining feedback using the AARS. Fig.2(b) shows the question and response categories in this case. This question was posed after three other questions of general nature, such as how they were feeling that particular morning, their reaction to the pace of the course, and what they expected to get out of the course. Sixty-three percent of the class felt that the feedback process seemed useful, twenty-eight percent did not wish to commit themselves without further experience. Two students felt that the whole procedure may be a waste of time, and one student could not see the correlation between the course and what was being tried to accomplish. There was one person who indicated an objection to the question. When asked to volunteer his reason for objection, it turned out that to him the question was not clear in that whether the process referred to the voing process or the whole system of obtaining feedback.

The objectives of using AARS in the Technology Assessment and Social Choice course were to obtain student feedback on the course content as well as to acquaint the students with a computer-based technological development for enhancing human interaction. A question on expectation from the course indicated a desire to attain a greater appreciation of technological and societal interactions on the part of more than half of the class. Two students emphasized to learn the ethical aspects of technology utilization in their response.

Another question of a different nature was posed to this class. This dealt with a survey of attitude toward premarital sex. Fig. 2 (c) shows the question and response categories. The last three categories were added on by the students. Their main objection to the first six categories was that the categories showed a bias and preconceived notions on the part of the person providing the six categories. All but one person indicated positive attitude toward premarital sex. The value of anonymity was very clear here. Voting results to another question demonstrated that if an individual's voting choice were recorded in a computer memory, nearly everyone would have felt cheated. The results show that the group had a liberal sex attitude, but still valued privacy highly.

The sixteen students participating in electronic voting were asked to pick a time period in which they would have preferred to have been born. Among alternatives varying in degree of civilization and technology, responses were widely varied (Fig. 2(d)). Three chose the cave; about half, a non-technological civilization; four present western society; and one, the future. The vote and discussion showed that over two-thirds of the participants preferred a non-technological society, or no society at all. This provides an interesting reflection on our modern lifestyle. The group expressed a sense of dissatisfaction with our present-day society.

CONCLUSION

The paper has outlined the use of a computer-based audience response system related to undergraduate course instruction. The objective was to acquaint the students with a unique application of the computers. The system was well-received by the students. It proved to be very effective as a feedback device in promoting a free and open dialog. The anonymity feature of the system was especially helpful in providing a sense of security and making the opinions known quickly and freely.

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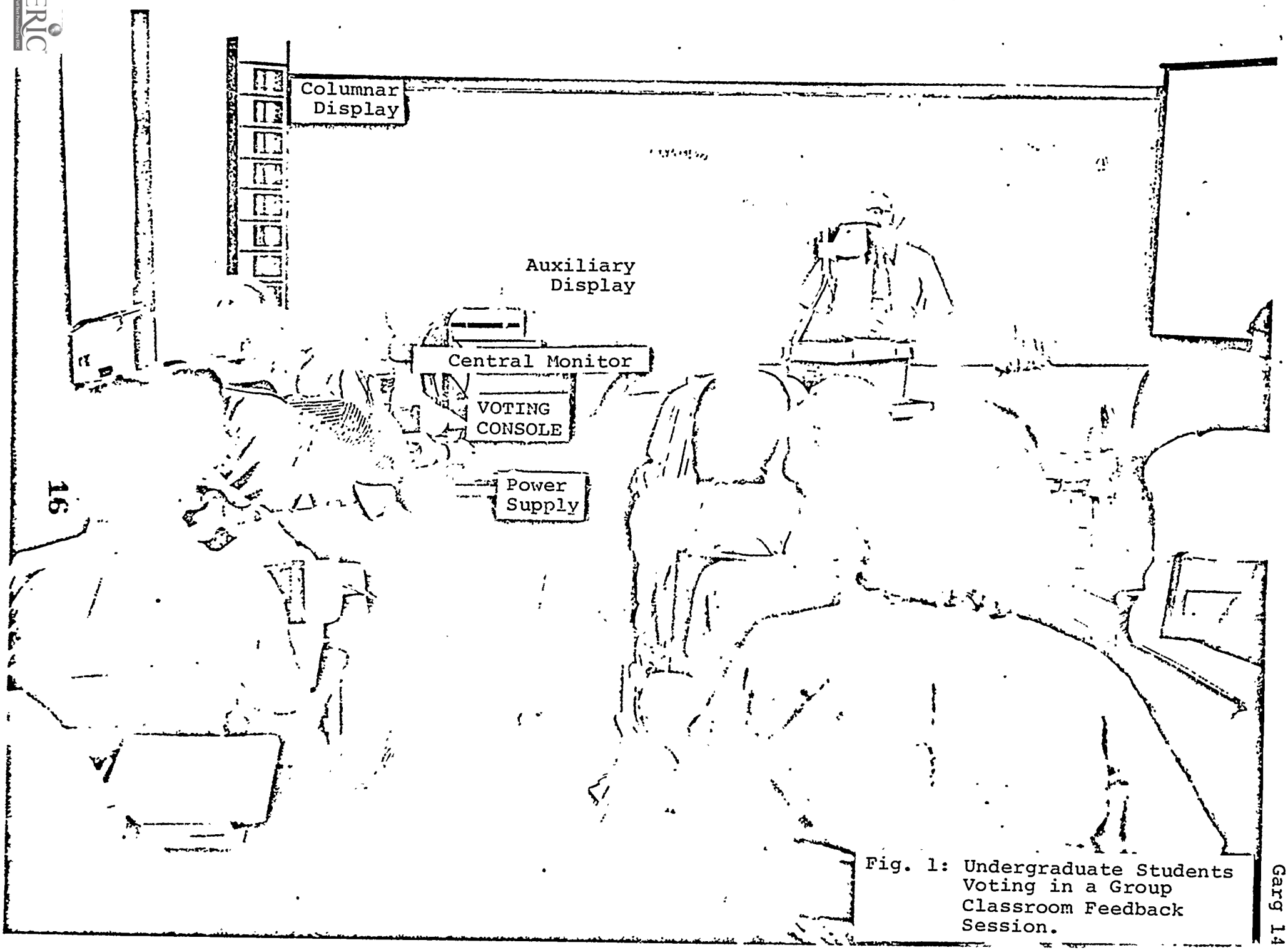

Fig. 1: Undergraduate Students Voting in a Group Classroom Feedback Session.

ATTITUDE TOWARDS COMPUTERS

I CONSIDER THE COMPUTERS TO BE:

1	GIANT BRAINS	4
2	SLAVES	5
3	OVER POWERING	1
4	THREATENING	1
5	INVADERS OF PRIVACY . .	0
6	TOOLS	8
7	CONFUSING	0
8	NONE OF THE ABOVE	0

(a)

INITIAL REACTION TO THE PROCESS:

1	LIKELY TO BE A WASTE OF TIME	2
2	INTERESTING, BUT UNRELATED TO WHY I AM HERE	1
3	I WILL RESERVE JUDGMENT UNTIL I SEE MORE	13
4	LOOKS LIKE IT MAY BE USEFUL	19
5	LIKELY TO BE VERY USEFUL	10
6	OBJECTION	1

(b)

PREMARITAL SEX IS ....

1	IMMORAL, I'M AGAIST IT !	1
2	IMMORAL, I'M FOR IT !	0
3	IMMORAL, I DON'T CARE EITHER WAY !	0
4	O.K., BUT SOCIETY MAKES A BIG DEAL OUT OF IT !	0
5	O.K. PROVIDED ONE DOESN'T GET CAUGHT !	0
6	WHAT IS PREMARITAL SEX ?	0
7	MORAL	0
8	O.K., IT IS A MATTER OF PERSONAL CHOICE	12
9	MORAL OR IMMORAL, I'M ALL FOR IT	4

(c)

IF THERE WERE A CHOICE OF BEING BORN IN A PARTICULAR TIME PERIOD, I WOULD HAVE CHOSEN ....

1	CAVE	3
2	NO TECHNOLOGY	3
3	NOW (WITH WESTERN TECHNOLOGY)	4
4	FUTURE, WITH TECHNOLOGY AND CIVILISATION	1
5	NONE OF THE ABOVE	0
6	OBJECT TO QUESTION	0
7	UNDECIDED	0
8	ELITE CLASS OF OPTION 2	4
9	BETWEEN 1 AND 2	1

(d)

Figure 2: Typical Questionnaires and Corresponding Votes From Various Class Sessions.