

VIS/ACT : The Next Episode'

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ABSTRACT

VIS/ACT is a multi-media educational system for aircrew coordination training (ACT). Students view video segments, answer questions that are adjusted to individual performance, and engage in related activities. Although the system puts the student in a reactive critiquing role, it has proved effective in improving performance on active targeted ACT skills, in group simulation tasks. VIS/ACT itself is the product of coordination among three Navy agencies.

OVERVIEW

The importance of aircrew coordination is widely accepted. A 1987 investigation "found that human error was the cause of between 60-80% of all aircraft incidents and accidents" and another recent study "concluded that these incidents and accidents are not a result of the inability to fly, but rather ineffective aircrew coordination." These quotes are from course materials prepared for the Navy Training Systems Center (NTSC) by MacCuish and Morgan (1991). In response to this problem, we have designed and implemented VIS/ACT, a video-oriented instructional system for ACT. The system itself is the product of coordination and close collaboration among instructional designers at NTSC, pilot-educators at the Atlantic Fleet Helicopter Operations School (AFHOS) and artificial intelligence specialists at the Naval Research Laboratory. Our respective roles are shown in Figure 1, a diagram of the development process.

VIS/ACT is a multi-media educational system that shows a video episode while the student categorizes and critiques the performance of the participants. Initially built with domain independent features, it has been specialized to aircrew coordination training (ACT). The system as specialized is intended as part of an NTSC curriculum in which the classification system is introduced earlier, in the classroom. The system permits flexible use of NTSC videos of aircrew episodes under the guidance of our computational tutor. The role of the tutor is to assure that the student absorbs the specific and general points of crew coordination that the video episodes are intended to convey. These points have been substantially elaborated by AFHOS personnel, who have also helped us to redesign the system to meet the actual needs of training, as well as the needs of these experts during the knowledge acquisition phase. The system runs under Hypercard and Lisp on a Mac-II. A PC-VCR provides computer control of on-screen videos.

SYSTEM

The specific purpose of VIS/ACT is to enhance pilots' aircrew coordination skills by increasing their ability to recognize and classify these skills. The NTSC course identifies 44 concrete, observable behaviors, each of which is associated with one of seven defined categories of crew coordination: mission analysis, leadership, decision making, assertiveness, situation awareness, communication and flexibility. The system (Figure 2) provides a framework in which students can watch on-screen videos of crews in action, classify the observed behaviors, and get immediate commentary on the accuracy of their observations. The current system evolved from a more broadly applicable implementation that allowed for an expert to enter domain information and specify various aspects of pedagogical strategy.

In order to provide appropriate feedback to the student, the system requires extensive knowledge about the contents of the video being viewed. A knowledge acquisition interface provides an environment in which an

ACT expert can mark the time intervals of major tape segments and of individual episodes within these segments. Because more than one crew coordination skill may be displayed in a short video clip, the expert enters a question that will be posed to the student in order to focus him or her on a specific crew activity. The expert then classifies the activity by specifying which crew member's actions are being addressed, whether or not good aircrew coordination skills are being displayed, and the specific skills and subskills that are involved in the targeted activity. He also provides a comment addressing the important aspects of the crew interchange, and an explanation of his reasoning for his classification choices.

In preparing a video tape for use by the student, the expert tries to mark all possible ACT activities, not all of which can or need to be viewed by a student in a single session. The system allows the expert to choose what percentage of the marked events should be shown at any given time, and what proportion of these, if any, should be biased toward the student's crew position or error record within the session. Based on these numbers and the information acquired about each video episode, the system, prior to each major tape segment, selects the video clips that the student will view within that segment.

A student interface allows students to view a video of a mission and to answer questions about each of its episodes. Required student entries can be adjusted to any of three levels of difficulty. Novices are only asked to judge whether or not good ACT skills are being employed. Intermediate students additionally identify the particular aircrew coordination skills involved in the episode. Potential ACT instructors must also select the relevant subskills for each skill they select (Figure 3). At each student level, the system commentary, generated using appropriately selected language templates, contains three kinds of information. First it presents the expert's narrative comment about the episode and the reasoning behind the expert's classification choices. The response then includes a comparison of the student's answer to the appropriate part of the expert's evaluation. In order to begin preparing students to master the next level of difficulty, the answer to both beginning and intermediate students incorporates the skill classification information that will be asked for at the next higher level. Upon completion, the system tells the student how well he or she did overall and in comparison to others of the same crew position. After informing the student of both the strong and the weak areas of performance, VIS/ACT recommends a next course of action.

As the student progresses through the session, the system updates two databases. One contains information about how successful students are at correctly answering individual questions and identifying the skills and subskills involved in the related video episode. The other keeps track of the ability of students in the same crew position to recognize a particular skill. The expert frequently names multiple skills and subskills for a single video episode. Since the student is expected to do likewise, partial credit must be allocated, in both the skill and subskill identification tasks, for selecting parts of the correct answer; additionally, credit is reduced for errors of commission. The credit formula is quite complex because the system needs equitable ratings at the level of subskill, skill and overall student performance.

RESULTS

Initial testing of VIS/ACT took place in February, 1993, at AFHOS. Testing objectives included validation of expert entries, determination of system refinement specifications, and evaluation of teaching effectiveness. Over 50 naval helicopter trainees were tested, with strongly favorable reactions, on the whole. Beyond mere acceptance, indications are that the system was effective in improving performance on targeted skills.

In part of the aircrew coordination training program, pairs of students fly a mission using a low-level simulation of a cockpit. During the mission, an instructor guides the crew through a prescribed scenario, and observes their use of aircrew coordination skills in completing the mission. When one of four training sessions that are part of the regular course was replaced by a VIS/ACT session, students showed a marked improvement in their use of crew coordination skills during the simulated mission, as judged on an objective observational scale by the AFHOS training instructors. Early indications are that despite placing the student in the role of a critic, outside the situation, use of the system improves performance on active skills, specifically the spontaneous use of appropriate communication behaviors in simulated missions. This result is consistent with others' findings that

"situated training in virtual contexts similar to the environments in which learner's skills will be used helps their knowledge to transfer." (Dede, 1992)

Initially the major value of VIS/ACT was thought to be in retraining as opposed to initial training. Used in either context, the system is designed for individual instruction. However, in order to expose more students to the system and thus get a more meaningful evaluation, the educators, in the later stages of testing, began using it in the classroom. By projecting the computer screen image to a larger screen, they were able to use the system to generate discussion in the classroom. In their view, using the system in this way increased the interaction among students and improved the effectiveness of the group session.

FUTURE

Some enhancements to the ACT specialization need to be made, including being able to track a student's progress over a series of sessions. Making the shift from VCR to CD-ROM would make the system more user-friendly by reducing delays. More importantly, it could provide immediate access to a library of mission videos, permitting the system to give the student a greater variety of opportunities to focus on his weak areas. Another objective is to provide avenues for increased student interaction. A proposed system would combine video with student voice communication by stopping a video at crucial points in a crew coordination activity, and having the student voice his response. The speech recognition and natural language processing that would be essential to such a system appear to be almost within the state of the art, as represented by Bates (1993). Not only syntactic and semantic analysis, but even discourse phenomena, would need to be handled in determining whether the student's communication conveyed the information known to be needed in the particular situation and evaluating other aspects of its appropriateness. An important notion here is that of a "target" communication, currently under experimental development at the NTSC. A target is a particular kind of communication behavior that is anticipated as the correct response to a particular event sequence. The target strategy has the potential of reducing the system's task to a manageable level.

PERSPECTIVE

It seems worthwhile to place VIS/ACT in the context of a variety of approaches to multi-media educational systems. With the advent of video on the computer screen comes the opportunity to turn computer-based tutoring and learning systems into .. television! In the light of television's dubious effects on students, we may wonder: will multi-media be the solution or part of the problem? Clearly, video on the computer screen is not an educational panacea. The exciting challenge is to place it under flexible control, in the service of educational goals. We see six ways to do this, one of which is the VIS/ACT strategy of providing and supervising relevant tasks, in order to give the student an active role in the proceedings, to assure that s/he is still receiving input, and to adjust the demands on the student as appropriate. Our approach, like several of the others touched on next, makes use of short clips of video material.

Approaches to avoiding the eyes-glaze-over behavior sometimes observed in response to straight television are to mingle it with: (i) a human teacher, (ii) itself, (iii) knowledge, (iv) structure, (v) manipulation and (vi) a relevant task, as in VIS/ACT. We elaborate on each of the first five just a bit, in turn. First, the teacher may mingle segments of video with question-and-answer, discussion and the like. For mixing video with itself, we have in mind the recombinant segments in the Athena's Project stories for language learning, which let the student have some control over the situation and which make a literary virtue out of computational shortcomings of not being quite sure what the student is up to (Murray, 1987). Mixing video with knowledge is represented by the strategy of Parkes and Self (1990), who ground tiny clips of video in a complex artificial intelligence-style knowledge representation. Mixing video with structure is the hyperization approach that Lynn Fontana (1991) is pursuing by making the not-so tiny clips of the Kenneth Burns Civil War tapes available at various nodes of a hypermedia semantic network. Finally, the manipulation approach of graphical user interfaces with learning environments, pioneered in Steamer (Holland, Hutchins, and Weitzman, 1984), is really an alternative to video, but can perhaps be usefully wedded to it.

ACKNOWLEDGMENTS

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References

- Bates, M. (1993) *Proceedings of the ARPA Human Language Technology Workshop, Plainsboro, NJ, March 21-24, 1993.*
- Dede, C.J. (1992) *The Future of Multimedia: Bridging to Virtual Worlds. Educational Technology, May, 1992, 54-60.*
- Fontana, L.A. (1991) *The Civil War Interactive. Instruction Delivery Systems, November/December 1991, 5(6), 5-9.*
- Holland, J. H., Hutchins, E.L., and Weitzman, L. (1984) *Steamer: An interactive inspectable simulation-based training system. AI Magazine, 5, 15-27.*
- MacCuish, D. A. and Morgan, B. B. (1991) *Aircrew Coordination Observer Training Program for Instructor Pilots. Orlando, FL: Naval Training Systems Center.*
- Murray, J.H. (1987) *Humanists in an institute of technology: How foreign languages are reshaping workstation computing at MIT. Academic Computing.*
- Parkes, A. P. and Self, J.A. (1990) *Towards "interactive video": A video-based intelligent tutoring environment. In Frasson, D. and Gauthier, G. (Eds.), Intelligent Tutoring Systems : At the Crossroads of Artificial Intelligence and Education. Norwood, NJ: Ablex Publ. Corp.*

Figure 1 ACT: 3-way Navy Collaborative Effort

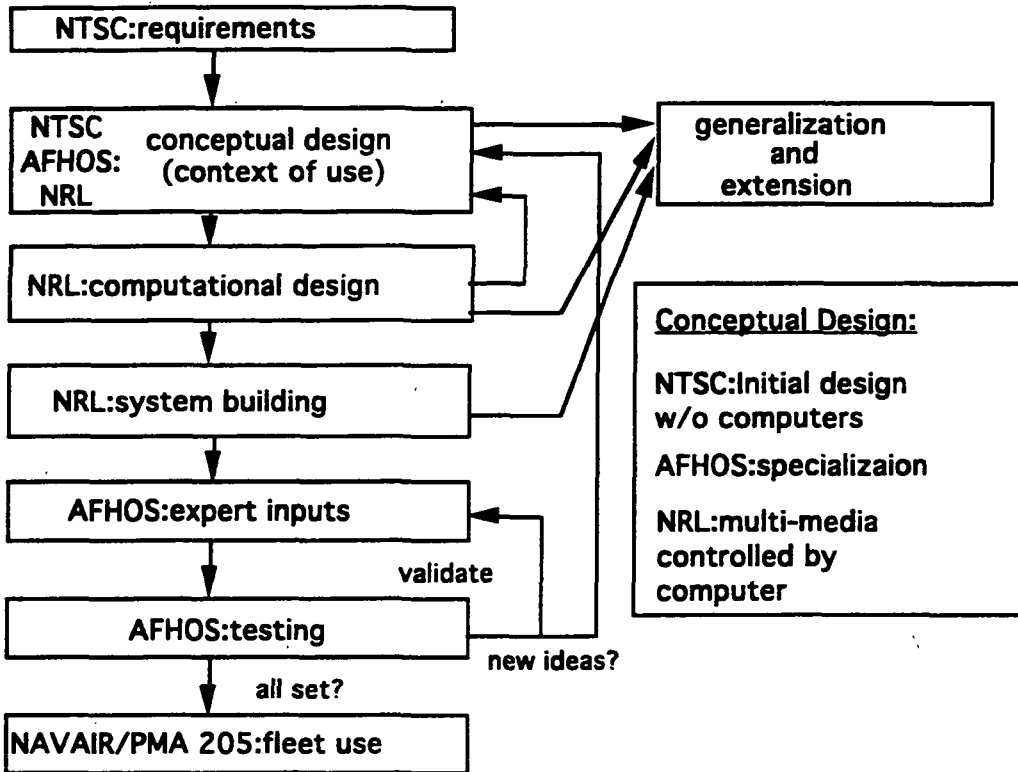


Figure 2 VIS/ACT: System Architecture, showing information flow

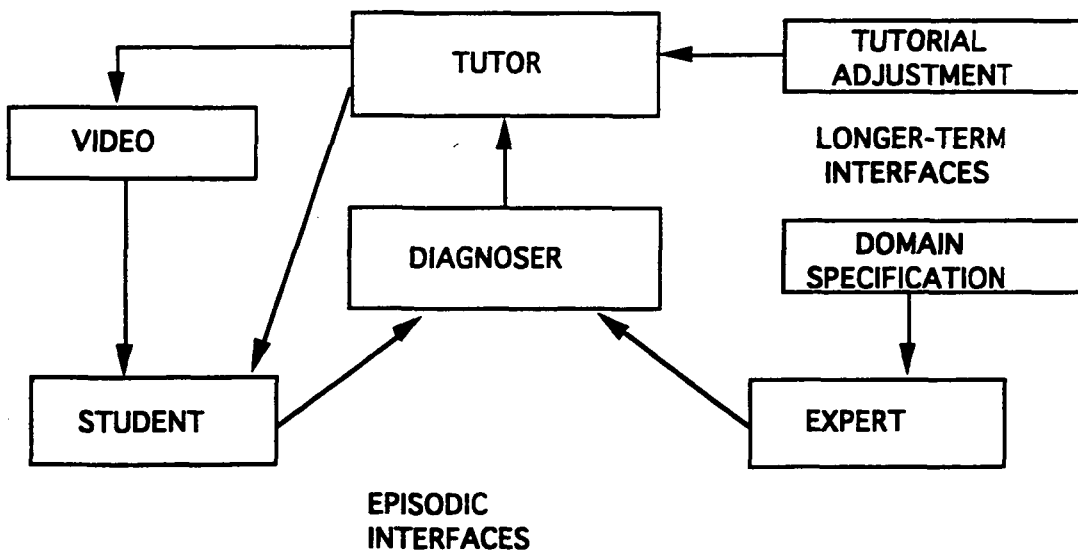


Figure 3 VIS/ACT: Student Interface (Level 3)

- 1 Determine mission requirements
- 2 Devise long and short term plans
- 3 Brief/establish personnel tasks
- 4 Identify impact of unplanned events
- 5 Prioritize tasks, plans, and objectives
- 6 Evaluated results of previous decisions
- 7 Update/critique existing plans

Live Video is OFF

11

clear entry

clear all

TAKEOFF & ENROUTE

QUESTION:

WERE PROPER ACT SKILLS EMPLOYED WHEN THE HAC REPLIED TO THE TOWER'S CLEARANCE TO LIFT ON LSE's SIGNAL?

MA AS DM AF SA LD CM

Good ACT: YES NO

OK

Event Analysis

SKILL	DIMINSION
SA	3 5
CM	2
MA	