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TRAINING MEDIA CONSTRAINTS AND LIMITATIONS.(U)
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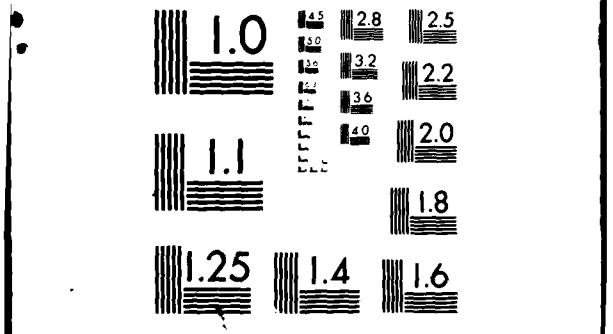
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(21) Report on

F-16 AIRCREW TRAINING DEVELOPMENT PROJECT

See also [redacted] AD-A099 844.

Contract No. F02604-79-C8875

(15)

(6) TRAINING MEDIA CONSTRAINTS AND LIMITATIONS,

(9) DEVELOPMENT REPORT, No. 33

MARCH 1981

(11)

(12) 15

Prepared in fulfillment of CDRL no. B045

by

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PREFACE

This report was created for the F-16 Aircrew Training Development Project contract no. F02604-79-C8875 for the Tactical Air Command to comply with the requirements of CDRL no. B045. The project entailed the design and development of an instructional system for the F-16 RTU and instructor pilots. During the course of the project, a series of development reports was issued describing processes and products. A list of those reports follows this page. The user is referred to Report No. 34, A Users Guide to the F-16 Training Development Reports, for an overview and explanation of the series, and Report No. 35, F-16 Final Report, for an overview of the Instructional System Development Project.

F-16 AIRCREW TRAINING DEVELOPMENT PROJECT REPORTS

Copies of these reports may be obtained by writing the Defense Technical Information Center, Cameron Station, Alexandria, Virginia 22314. All reports were reviewed and updated in March 81.

Gibbons, A.S., Rolnick, S.J., Mudrick, D. & Farrow, D.R. Program work plan (F-16 Development Report No. 1). San Diego, Calif.: Courseware, Inc., September 1977, March 1981.

Thompson, A., Bath, W., & Gibbons, A.S., Previous ISD program review (F-16 Development Report No. 2). San Diego, Calif.: Courseware, Inc., September 1977, March 1981.

Wild, M., & Farrow, D.R. Data collection and management forms report (F-16 Development Report No. 3). San Diego, Calif.: Courseware, Inc., September 1977, March 1981.

Gibbons, A.S. Review of existing F-16 task analysis (F-16 Development Report No. 4). San Diego, Calif.: Courseware, Inc., June 1977, March 1981.

Gibbons, A.S., & Rolnick, S.J. Derivation, formatting, and use of criterion-referenced objectives (CROs) and criterion-referenced tests (CRTs) (F-16 Development Report No. 5). San Diego, Calif.: Courseware, Inc., September 1977, March 1981.

Rolnick, S.J., Mudrick, D., Gibbons, A.S. & Clark, J. F-16 task analysis, criterion-referenced objective, and objectives hierarchy report (F-16 Development Report No. 6). San Diego, Calif.: Courseware, Inc., October 1978, March 1981.

Gibbons, A.S. Task analysis methodology report (F-16 Development Report No. 7). San Diego, Calif.: Courseware, Inc., October 1978, March 1981.

Gibbons, A.S. Objectives hierarchy analysis methodology report (F-16 Development Report No. 8). San Diego, Calif.: Courseware, Inc., October 1978, March 1981.

Mudrick, D., Gibbons, A.S., & Schmidt, R.F. Goal analysis report (F-16 Development Report No. 9). San Diego, Calif.: Courseware, Inc., February 1978, March 1981.

Rolnick, S.J., Mudrick, D., & Thompson, E.A. Data base update procedures report (F-16 Development Report No. 10). San Diego, Calif.: Courseware, Inc., October 1978, March 1981.

Mudrick, D., & Pyrz, K.E. Data automation of task and goal analysis: Existing system review and recommendation (F-16 Development Report No. 11). San Diego, Calif.: Courseware, Inc., September 1977, March 1981.

O'Neal, A.F., & Smith, L.H. Management System needs and design concept analysis (F-16 Development Report No. 12). San Diego, Calif.: Courseware, Inc., December 1977, March 1981.

Gibbons, A.S., Thompson, E.A., Schmidt, R.F., & Rolnick, S.J. F-16 pilot and instructor pilot target population study (F-16 Development Report No. 13). San Diego, Calif.: Courseware, Inc., September 1977, March 1981.

Schmidt, R.F., Gibbons, A.S., Jacobs, R. & Faust, G.W. Recommendations for the F-16 performance measurement system (F-16 Development Report No. 14). San Diego, Calif.: Courseware, Inc., October 1978, March 1981.

Thompson, E.A., & Gibbons, A.S. Program/system constraints analysis report (F-16 Development Report No. 15). San Diego, Calif.: Courseware, Inc., October 1978, March 1981.

Gibbons, A.S., & Rolnick, S.J. A study of media production and reproduction options for the F-16 project (F-16 Development Report No. 16). San Diego, Calif.: Courseware, Inc., February 1978, March 1981.

O'Neal, A.F., & Kearsley, G.P. Computer managed instruction for the F-16 training program (F-16 Development Report No. 17). San Diego, Calif.: Courseware, Inc., July 1978, March 1981.

Wilcox, W.C., McNabb, W.J., & Farrow, D.R. F-16 implementation and management plan report (F-16 Development Report No. 18). San Diego, Calif.: Courseware, Inc., October 1978, March 1981.

Sudweeks, R.R., Rolnick, S.J., & Gibbons, A.S. Quality control plans, procedures, and rationale for the F-16 pilot training system (F-16 Development Report No. 19). San Diego, Calif.: Courseware, Inc., October 1978, March 1981.

Gibbons, A.S., Axtell, R.H., & Hughes, J.A. F-16 media selection and utilization plan report (F-16 Development Report No. 20). San Diego, Calif.: Courseware, Inc., October 1978, March 1981.

Thompson, E.A., Kearsley, G.P., Gibbons, A.S., & King, K. F-16 instructional system cost study report (F-16 Development Report No. 21). San Diego, Calif.: Courseware, Inc., October 1978, March 1981.

Jacobs, R.S., & Gibbons, A.S. Recommendations for F-16 operational flight trainer (OFT) design improvements (F-16 Development Report No. 22). San Diego, Calif.: Courseware, Inc., October 1978, March 1981.

Gibbons, A.S. F-16 instructional sequencing plan report (F-16 Development Report No. 23). San Diego, Calif.: Courseware, Inc., October 1978, March 1981.

Farrow, D.R., & King, K. F-16 coursewares and syllabi delivery schedule (F-16 Development Report No. 24). San Diego, Calif.: Courseware, Inc., September 1979, March 1981.

Rothstein, L.J., Hibian, J.E., & Mudrick, D. F-16 instructor/course manager training requirements report (F-16 Development Report No. 25). San Diego, Calif.: Courseware, Inc., October 1978, March 1981.

O'Neal, A.F., & O'Neal, H.L. F-16 pilot media selection (F-16 Development Report No. 26). San Diego, Calif.: Courseware, Inc., March 1979, March 1981.

Gibbons, A.S. F-16 instructional system design alternatives (F-16 Development Report No. 27). San Diego, Calif.: Courseware, Inc., September 1979, March 1981.

Gibbons, A.S. F-16 instructional system basing concept (F-16 Development Report No. 28). San Diego, Calif.: Courseware, Inc., September 1979, March 1981.

O'Neal, H.L., & Rothstein, L.J. Task listings and criterion-referenced objectives for the Instructor pilot F-16 training program (F-16 Development Report No. 29). San Diego, Calif.: Courseware, Inc., September 1979, March 1981.

Bergman, D.W., & Farrow, D.R. F-16 training system media report (F-16 Development Report No. 30). San Diego, Calif.: Courseware, Inc., September 1979, March 1981.

Gibbons, A.S., O'Neal, A.F., Farrow, D.R., Axtell, R.H., & Hughes, J.A. F-16 training media mix (F-16 Development Report No. 31). San Diego, Calif.: Courseware, Inc. October, 1979, March 1981.

Farrow, D.R. F-16 training media support requirements (F-16 Development Report No. 32). San Diego, Calif.: Courseware, Inc., September 1979, March 1981.

Gibbons, A.S. F-16 training media constraints and limitations (F-16 Development Report No. 33). San Diego, Calif.: Courseware, Inc., September 1979, March 1981.

Farrow, D.R., & Kearsley, G.P. A user's guide to the F-16 training development reports (F-16 Development Report No. 34). San Diego, Calif.: Courseware, Inc., January 1981, March 1981.

Farrow, D.R., & Clark, J. F-16 Final Report (F-16 Development Report No. 35). San Diego, Calif.: Courseware, Inc., January 1981, March 1981.

EXECUTIVE SUMMARY

The purpose of this report is to list and discuss the constraints and limits of the various instructional media employed in F-16 training, with the purpose of targeting these limitations for future upgrading. The five major limitations include: (1) the limited number of training devices available, (2) the unavailability of certain types of training devices, (3) the inability to impact the design of training devices because of the exceptionally long procurement cycle, (4) the use of less than optimal devices, and (5) the limited range of media available for implementation in the F-16 training system.

The report identifies four conditions that acted to predispose the media selection process to the constraints identified above. First, the F-16 syllabus had to be constructed to meet preexisting aircraft use level expectations instead of allowing instructional considerations to drive the use level. Second, major training devices were designed and procured before specific training uses for those devices were generated. Third, no instructional design expertise was employed during the initial stages of training device design and procurement. Finally, adequate funds and command attention were not directed to the procurement of major F-16 training devices.

Based upon these constraints and limitations, the report makes six specific recommendations: (1) establish and execute a plan for system growth that will eventually minimize these constraints, (2) design simulated practice environments an scenarios that take fullest advantage of the capabilities of existing training devices, (3) maintain and update the data-based syllabus created during the development phase and utilize feedback from evaluations to adjust the syllabus, (4) examine the training functions allocated to each training device to consider possible reassignment to other media, (5) employ state-of-the-art training techniques to increase the efficiency of training device utilization, and (6) carefully monitor training device use and availability to ensure the fullest use of training device time.

CONTENTS

TRAINING MEDIA CONSTRAINTS AND LIMITATIONS

1.0 PURPOSE AND ORGANIZATION

The purpose of this report is to identify the constraints that affected the media recommended for use in the F-16 training system. The purposes for doing this are: (1) to identify the limitations associated with the media selection efforts for the present F-16 training system so that future system decisions can be oriented toward their removal, and (2) to identify areas of potential growth within the F-16 training system which will become feasible as existing constraints are removed by time.

Media recommendations for the F-16 training system are made in project report no. 31, "F-16 Training Media Mix." Other reports discussing the media selection process itself include no. 30, "F-16 Training System Media Report," no. 32, "F-16 Training Media Support Requirements," and no. 33, "F-16 Training Media Constraints and Limitations."

Media selection is the process of maximizing the benefits obtained from training media while minimizing the cost. More than choosing the least expensive media, media selection is a process of balancing capability and cost along with several other factors to obtain the best media mix. The full range of factors considered in the process includes such things as cost, lead time for procurement, requirement for specialized procurements, maintenance requirements in terms of facilities and personnel, operational expense, difficulty of revision, existence of required production support facilities, and several other factors.

A constraint can be placed upon media selection because of existing conditions in any of these areas. Adequate production facilities may not exist, costs may be too high for current budgets, or lead times required to ready media for use may be too long for short-range use. Designs are often created by instructional designers which require sophisticated media to execute sophisticated training routines, but in some cases constraints do not allow the use of those media devices. In those cases the designer acknowledges the real world by adjusting the training plan to accommodate the less than optimal training environment.

Constraints affecting media selections usually change with time. New sources of support may be constructed or identified

through reorganization, operating costs may be reduced, and once expensive systems of media may become relatively less expensive as other training resource costs rise. As this happens, the original plans of the designer become attainable, and the system may be modified to operate more effectively.

In the design of the F-16 training system several constraints were operating as media were selected, and the final media selections reflect the best accommodation to those existing conditions. This report contains recommendations and references to plans which are intended to diminish the effects of the constraints experienced in the F-16 media selection process. Some of the constraints acting on the F-16 selections are removable, and this report references plans which have been made for the growth of the system as they are taken away. Other constraints which affected media selections were the result of institutional and timing factors which caused decisions to be made which will not be easily reversed. Recognition of those factors and plans for dealing with them are also referenced in this report.

This report is organized to present the limitations of the current F-16 media selections and the factors that have influenced them. Section 2.0 names the limitations. Section 3.0 describes the conditions which governed the media selections and gave rise to the limitations. Section 4.0 describes the result and recommends approaches for dealing with these constraints in the future.

Discussions in this report which refer to instructional media should be understood to refer to both academic media presentation devices and simulation training devices, which in many cases attempt to represent physical properties of the cockpit.

2.0 F-16 MEDIA CONSTRAINTS AND LIMITATIONS

The constraints and limitations inherent in F-16 media selections include limitations on (1) the instructional strategies which may be implemented with the student and (2) the range of instructional and simulation experiences which may be provided under the present media selections. These constraints arise for several reasons:

1. Number of devices: Some constraints are experienced due to the number of training devices in which extensive training experience is desired but not possible. Examples of devices which are constrained in this way are the aircraft and the Operational Flight Trainer (OFT). Constraints on these two devices serve as the major limiting factor in the design of the F-16 training system. Not only are media decisions affected, but management, scheduling, and syllabus decisions as well.

2. Unavailable devices: Some instructional media devices are unavailable for use in F-16 training program due to cost and time factors. Presentation devices automated by computer, such as computer-assisted instruction, are among the unavailable media recommended for F-16 training. A second class of devices includes the part-task trainer. This is a computer-driven simulation of the operation of certain complex physical systems of the aircraft, such as the Stores Management Set (SMS) and the Fire Control/Navigation Panel (FCNP), not only as isolated systems, but in interaction as well.

3. Early procurement of devices: Recommendations for the modification and use of some of the F-16 training devices have been made in the course of the F-16 training development project. For example, development report no. 22, "Recommendations for F-16 Operational Flight Trainer (OFT) Design Improvements," recommends 14 separate modifications to the OFT that would make it more effective instructionally. At present there are no definite plans to implement these recommendations.

4. Less than optimal devices: In some cases instructional devices procured for use in F-16 training were not reviewed by instructional design personnel for instructional utility. The concept behind some of these devices was sound, but the design lacked some features which would make the device more capable instructionally. For example, both the Cockpit Procedures Trainer (CPT) and Egress Proceduress Trainer (EPT) were designed prior to review by the instructional design team.

5. Limited media: Since computer-assisted instruction (CAI) and part-task trainers were unavailable due to cost and time factors, a practical rather than ideal approach to media selection was used. This approach emphasized mixing those media that were available into an acceptable instruction system. The unavailability of media has probably caused some compromise in the quality of instruction, but the resulting system is well within reasonable tolerances in terms of instructional adequacy. It is hoped, however, that future considerations will include the possibility of using CAI.

As a result of the factors listed above, the media selection for the F-16 training system did not include the full range of available media. From a theoretical perspective, this selection is less than ideal, but the realities of real world constraints often dictate instructional development outcomes. This should not stop future efforts aimed at improving the system.

3.0 CONDITIONS AND PRACTICES ACTING AS PRECURSORS TO MEDIA CONSTRAINTS

This section identifies the main factors operating in the determination of F-16 media constraints. The following four problems impact F-16 media capabilities:

1. Necessity of constructing F-16 syllabi to meet preexisting aircraft use level expectations: It is a common but less than optimal situation in aircrew training that the major syllabus parameters are set far in advance of determining what must be trained. Instructional developers for aircrew training are consistently asked to build the "optimal" syllabus but to do it within "no more than X number" of rides. This is a reversal of the logical order of development. To determine how much flight time will be used in training it is more logical to first determine what will be instructed and how. Nonetheless, it has become standard practice to state the amount of flight time available and build the syllabus around that value.

2. Ordering of training devices without consideration of specific training requirements or concomitant volume of use: The long lead time required for the procurement of training devices often requires them to be ordered way in advance of the determination of exact training requirements. This again is a reversal of the logical order of development processes and works against the design of training devices matched to training needs. Most important in this respect, it forces the procurement of training devices based on subjective judgements and traditional device procurement patterns.

3. Omission of instructional design expertise from initial stages of training system and training device design and procurement: The problems described in the previous paragraph related to the early ordering of training devices are compounded by the normal practice of not involving instructional designers in the training device design and procurement process. On the F-16 project, more than on most projects for aircrew training development, the instructional designer did play an active part in this process, but only in the very terminal stages of device design, and only for one device, the OFT. Even at early stages of weapon system development, there is enough data available concerning weapon characteristics and missions to make some generalizations about the training burden, and device designs which normally begin to evolve at this stage could profit from what techniques an instructional designer could bring to bear on the device design problem. Techniques for achieving this and specific timelines and design decisions are

described in "Fleet Aviation Instructional Systems Development Model: For Emerging Weapon Systems," a report prepared for the US Navy Training Equipment Center under contract no. N61339-76-C-0062.

4. Allocation of funds and attention to development of the training program and its training devices: For the F-16 program more than most other programs an attempt has been made to allocate adequate funds and command attention to the development of a training system. Though there have been many lessons learned in this attempt to interface contractor and military personnel, there has been much success attributable to the proper funding and proper management of many areas of the project. Even with these successes, there have been some areas in which better funding or better management of the development processes would have netted additional benefits and efficiencies for the training system. Proper design of an entire range of training devices needed, for instance, is an area in which the F-16 project could have improved. This range of training devices, balanced to obtain maximum effective use of all devices at minimum overall cost, would include not only simulation media, but academic instructional media as well.

4.0 RECOMMENDATIONS FOR MINIMIZING CONSTRAINT EFFECTS

This section makes recommendations for minimizing the effects of constraints upon the F-16 system. The main recommendation centers on removing the constraints through appropriate levels of funding for system improvements over a period of time. Other recommendations deal with policies which may be implemented independent of the decision to improve the system through growth. The recommendations follow below.

Recommendation 1: Follow a plan of system growth which would eventually reduce constraints. A plan for system growth in both instructional and management capabilities has been issued in project report no. 27, "F-16 Instructional System Design Alternatives." That report recommends a series of five major steps of system growth which would remove the majority of the constraints identified in this report, including constraints on the range of training devices available for use and limits on the amount of time available for use on more expensive devices. Easing the limitations of time available on expensive devices, of course, would be in some ways analogous to obtaining additional copies of training devices. Instructional strategy constraints would be removed for both academic media and for the use of training devices in simulations so far as training device capabilites would allow it. Constraints remaining would be those relative to the original design of the training devices for instructional functions. Shortcomings in training devices already procured would not be removed.

Recommendation 2: Pay additional attention to the design of simulated practice environments and scenarios that use to the fullest extent the capabilities of existing training devices. If new devices with better instructional capabilities can not be procured for F-16 use, it may be possible to derive additional instructional benefit from utilization of existing devices in novel ways. In most cases this would involve the creation of simulations which were less and less equipment-centered and more and more student and mental-rehearsal centered. Research has demonstrated the effectiveness of mental simulation carried out through mental rehearsal techniques. Even simulations which have equipment related to them can involve an element of mental rehearsal. It is not unreasonable to look at the amount of environment supplied mentally by the student during an exercise as a major dimension of the idea of a simulation.

Recommendation 3: Carefully maintain the data-based llabus created during development and utilize feedback from evaluations to adjust the syllabus for efficiency. The syllabus constructed for F-16 B/C course training was built according to principles that insured (1) that every event included in every sortie was justified as a required training event, (2) that sorties did not include more than what could be accomplished during the time alotted, and (3) that adequate time was reserved for each event. Underlying the syllabus is a data bank which specifies for each task to be learned the best estimate which could be made of the number of demonstrations, practices, and evaluations required by the typical student to learn to perform the task. The syllabus is a reflection of this data. As experience in teaching students accumulates, the original estimates used to build the syllabus will be either verified or disputed. The data to do this will come through the gradeslip, since entries are to be made on F-16 gradeslips of actual numbers of practices of each event. When it is found that the practice amount for a particular task was overestimated, the appropriate reduction can take place in the amount of syllabus time allotted to the task. An effort will be made to "push down" training tasks to less and less expensive media without compromising instructional effectiveness. Underestimates, of course, must be handled by adding the appropriate amount of practice. If the syllabus is properly maintained, there is a high probability that opportunities for economy will be found in the overestimations which exist within the syllabus.

At some future time, as the F-16 management system is computerized, the syllabus process also could be computerized to make the adjustment of the syllabus automatic, based on current student performances. The logical extension of this idea, of course, is that the F-16 training system would be able to produce for each student a unique syllabus, including media selection, generated by computer and tailored to the needs and learning rate of each student. The exact needs of each student could be generated through manipulation of the student's own performance data and the syllabus data base. Gradeslips under this mode of

operation would be generated prior to each flight for the particular student. Since this method of syllabus generation would move many students through training ahead of the average pace, it can be anticipated that it would affect important and large economies in training costs without incurring many of the negative motivational side-effects of other plans for moving fast students through training more rapidly. Under this mode of operation, however, it would be important to see to it that students who moved through training rapidly perceived it as beneficial to themselves to do so. Antimotivating pressures would otherwise reduce the effectiveness of the system.

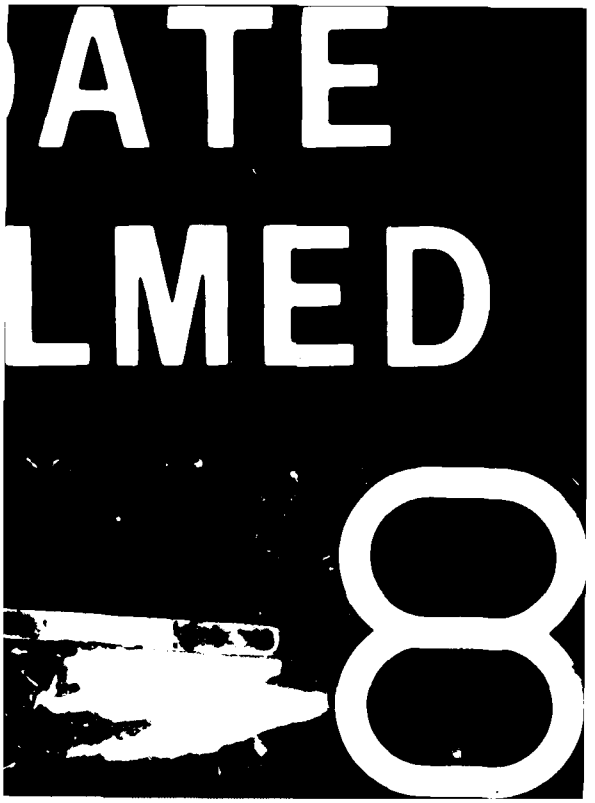
Recommendation 4: Study the training functions allocated to each training device to determine possible reassignment of training to devices. Because the F-16 syllabus and media selections were carried out by experts with opinions, it is possible that in some cases training of some tasks was assigned on the basis of tradition rather than on the basis of a well-thought instructional plan. It is possible that some functions designated for simulator training are more appropriate only for the aircraft, or vice versa. Past decisions will become subject to review, especially upon delivery of the OFT for training and as instructors learn what can and cannot be adequately practiced in it.

In a reevaluation to be completed later in the project, contractor and military personnel will create a listing of the tasks assigned to each medium for instruction. These lists will be scanned to determine possible better assignments or misassignments of tasks to training media. This work will occur under the requirements of CDRL B047, "Ground Based Training Limitations." In addition, evaluation data will help identify those areas that need better assignments.

Recommendation 5: Employ up-to-date training methods where possible to increase the efficiency of training time. Several methods which are not currently standard practice in aircrew training have been demonstrated through research and development efforts to be effective in producing skilled performers with less training resource requirement on some tasks. Techniques researched by AF Human Resources Laboratory, Williams AFB, Arizona using backward chaining in simulator instruction have demonstrated high efficiency rates. The employment of these techniques first on a test basis and then if feasible on a full-scale basis has been recommended in other project documentation. It is expected that savings of training device time could be effected by doing so.

Recommendation 6: Carefully monitor training device use and availability data to insure the fullest use of training device time. The formative evaluation subsystem designed as part of the F-16 training system will be designed to collect usage data on all training devices. Training devices which are counted in the syllabus but not available because of inefficient use or breakdowns are costly to system operation. A future project task will

investigate training device availability (CDRL B046, "Training Device Availability") and assess its impact on the flow of students through the syllabus. It is important that the role of the evaluation system in collecting and reporting data on device usage be implemented and used to adjust system policy and practices.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