Instructional Strategies for Exercise Manipulation in Distributed Mission Training

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ABSTRACT

Distributed Mission Training (DMT) provides enhanced realism to simulation-based training events by involving numerous friendly and adversary forces. Given the added complexity of this environment, instructors in DMT environments have a cognitively-complex job that involves maintaining awareness of a vast amount of information, making rapid decisions, conducting performance diagnosis, executing actions to control the simulation, and developing AAR materials. The present work was an investigation to determine the strategies used by instructors to manage DMT exercises. The analysis provided insights regarding software tools that might alleviate the cognitive load imposed on instructors during DMT events. Both the scientific literature and current practices of DMT instructors were examined. The literature revealed little useful information regarding specific strategies and tools that instructors use to manage exercises and enhance training value but did provide insights regarding new ways to capture and represent essential aspects of DMT exercise manipulation. To assess current practices of instructors, interviews were conducted with seven instructors at the Naval Strike and Air Warfare Center and four instructors representing Army, Navy SEAL, and Air Force DMT domains. The interviews revealed that: 1) instructors thoroughly plan and identify contingencies in a scenario before an exercise, 2) despite such thorough planning, scenario execution involves a significant amount of exercise manipulation, and 3) manipulations are generally administered to maintain training integrity and preserve safety. Overall, the findings implied several opportunities for instructor support tools that facilitate: manipulation administration, prediction of manipulation effects, linking manipulations to training objectives, and instructor-instructor collaboration for both coordination and administration of manipulations.

ABOUT THE AUTHORS

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INTRODUCTION

Distributed Mission Training (DMT) provides a more realistic context for training by involving numerous friendly and adversary forces in live, virtual, or constructive simulations. However, heightened realism also involves heightened complexity for the personnel responsible for conducting the training. Instructors in DMT environments have a complex job that involves maintaining awareness of a vast amount of information, making rapid decisions, diagnosing performance, taking actions to control the simulation, and developing after-action review (AAR) materials. The tasks must be performed by the instructor during an exercise. Not surprisingly, instructors have indicated experiencing cognitive overload (Walwanis Nelson, Owens, Smith, & Bergondy-Wilhem, 2003). The motivation of the present study was to begin to identify ways in which tools may alleviate such cognitive load for instructors during scenario execution.

Woods and Christoffersen (2002) discuss the important role research plays in developing innovative systems, particularly in relation to complex socio-technical systems such as embodied in the DMT environment. Their approach contrasts sharply with the traditional research and development ‘pipeline’ approach, in which human factors analysts are brought into the development process for post-hoc analysis, or fixing of various aspects of the system. Instead of fixing a system after it has been developed, the development framework proposed by Woods and Christoffersen (see Figure 1) utilizes the skills and expertise of human factors analysts in the early stages of the development cycle.

The present work paralleled the Woods and Christoffersen (2002) practice-centered approach to research in its focus upon field observations to produce an initial set of behavioral patterns that should, in turn, lead to better design and development of the tools instructors need to control a DMT exercise scenario.

METHOD

The two efforts, the State of the Science literature review and the State of the Practice evaluation, were conducted in parallel.

State of the Science

The State of the Science review examined over 50 articles related to current instructional practices in simulation-based and DMT. The State of the Science information was enhanced through additional data collected during a State of the Practice evaluation.
State of the Practice

The State of the Practice evaluation engaged Navy and Marine Corp instructors of the The Naval Strike and Air Warfare Center (NSAWC) located at Fallon Naval Air Station, Nevada. Air warfare training conducted at NSAWC involves live flights with simulated weapons. In general, a DMT environment may include any combination of live, simulated, or constructive entities that may all interact. NSAWC affords a highly dynamic context from which an improved understanding of instructional practices in DMT can be derived. Also, NSAWC instructors represent an appropriate user group from which observations of exercise control may be collected and initial behavior patterns defined.

Additional military instructors from other distributed training environments were interviewed. The additional instructors were interviewed in an effort to begin to uncover patterns of instructional behavior across DMT domains.

In addition to interviews, information about the State of the Practice was also collected through observations. These observations included live-fire, aviation training conducted at NSAWC and Fire Support Team (FiST) practical applications (i.e., low-fidelity simulations) conducted at the Expeditionary Warfare Training Group Atlantic (EWTGLANT).

Participants

Eleven military instructors participated in the research study. The majority of instructors interviewed were from the Navy; however, instructors from the Marine Corps, Army, SEAL and Air Force Services were also interviewed. The average time in service was 11.8 years, S.D. = 5.1 years. Detailed demographic information for participants can be found in Table 1.

Materials

The interview materials contained three components. First, standard demographic questions were used to collect instructor background information. Second, a set of domain complexity questions were developed to determine how instructors characterize the complexity of their work environment. In a DMT environment, the “system” includes the instructors, trainees, role players (live or simulated), and all of the equipment used to perform, monitor, and control the exercise. In addition, effects of the environment were considered because of their important influence on the behavior of the system.

Table 1. Demographic Information of Participants

<table>
<thead>
<tr>
<th>N</th>
<th>Service</th>
<th>Rank/Status</th>
<th>Mean Yrs in Service</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Navy</td>
<td>CDR</td>
<td>16.5</td>
</tr>
<tr>
<td>1</td>
<td>Navy</td>
<td>LCDR</td>
<td>15</td>
</tr>
<tr>
<td>4</td>
<td>Navy</td>
<td>LT</td>
<td>7.4</td>
</tr>
<tr>
<td>1</td>
<td>Marine Corps</td>
<td>Lt. Col.</td>
<td>-</td>
</tr>
<tr>
<td>2</td>
<td>Army</td>
<td>Lt. Col., Retired &amp; Reserves</td>
<td>14.5</td>
</tr>
<tr>
<td>1</td>
<td>SEAL</td>
<td>PO1, Retired</td>
<td>11</td>
</tr>
<tr>
<td>1</td>
<td>Air Force</td>
<td>Lt. Col., National Guard</td>
<td>18</td>
</tr>
</tbody>
</table>

Such a system is considered a complex socio-technical system. Vicente’s (1999) definitions of what constitutes a complex socio-technical system served as the structure for identifying how instructors characterize the training environment in which they work.

Third, standard NSAWC training scenarios were used to provide a scenario-based framework that offered a familiar context for the instructors to situate examples. Probe questions were constructed as a means to ask instructors about how they control a scenario as it unfolds. The questions focused upon how instructors interact with the trainees and the scenario during the trainee planning period and during the execution of a training event. A single training event includes five primary steps: instructor planning, trainee planning, instructor re-planning, scenario execution, and debriefing and AAR. Exercise manipulation begins when the trainees start to interact with the scenario during trainee planning and continues through scenario execution. During AAR, instructors may use what-if techniques to expand the set of situations considered by trainees, but this is not considered exercise manipulation and is a separate learning technique.

The NSAWC scenarios were used for both NSAWC and non-NSAWC interviewees as they included a number of engagement dimensions. For example, the Close Air Support (CAS) mission includes both aviation and ground forces, so the scenarios were familiar across domains.

Procedure

Each interview consisted of three parts, corresponding to the three components of the interview materials: 1) introduction, informed consent, collection of demographic data; 2) collection of domain complexity data; and 3) collection of scenario execution and control.
data using the scenario-based current practices questions. Interviews were conducted on-site at the NSAWC facility with the NSAWC instructors and the other interviews were conducted in an office setting.

The analysis focused on the qualitative domain complexity and scenario data. Analysis of all data was done via a consensus approach in which raters first made independent ratings and then met to reach a consensus about the ratings. Raters included both the interviewers and other research team members who had not participated in the preparation process. All raters attended a training session prior to data analysis.

The scenario explanations were evaluated on several points. First, was it an instance in which a manipulation would be administered, or not administered? Subsequent questions aimed to identify the specific information involved in administering the manipulation. In cases where instructors indicated they would not perform a manipulation, some questions did not apply. The following questions were asked:

- **Who** executes the actions involved to create the exercise manipulation (e.g., instructor, support personnel)?
- **When** is the manipulation performed or feedback given (e.g., during the briefing planning period, execution, or debriefing and/or AAR)?
- **How** was the manipulation realized (e.g., verbally over radio, verbally directly to the trainee, or using control equipment)?
- **What** was the purpose of performing the manipulation (e.g., training value, safety)?

### RESULTS

#### State of the Science

The literature review provided a theoretical foundation for evaluating the current practices and to begin envisioning future capabilities to provide instructors. The task included a review of approximately 50 articles that addressed a breadth of training topics including, but not limited to: training feedback, simulation training technology, team training, performance measurement, and instructional strategies. Information from the review did not directly reveal an optimal path for the development of instructional strategies for real-time exercise manipulation in a DMT environment. However, the review produced: 1) a description of the technology and environment that enable DMT, 2) information about training approaches, in particular the

#### Training Technology

Proctor and Lipinski (2000) addressed distributed simulation training technology by defining ‘distributed’ and ‘simulation.’ Simply, people who are geographically separated and have access to communication networks that support a “mix and match” of simulation technologies are now able to interact in ways comparable to live interactions. Indeed, military teams now have the capability to virtually “train the way they intend to fight” (George & Fuller, 2000, p. 1).

The literature includes strong support of using distributed simulation technologies to support training. Several reports focus on simulation tools for training specifically to alleviate costs associated with live training and other benefits such as safety and limitations of live training environments (e.g., Alluisi, 1991; Miller & Thorpe, 1995; Orlansky, Taylor, Levine, & Honig, 1997; Proctor & Lipinski, 2000; Simpson & Oser, 2003).

The review also produced evidence that there is a recognized need for more research to develop and use the technology properly in training our armed forces. In particular, Bell (1999) stated that “training is substantially more than putting hardware and software systems to work together. It involves managing the participants' training experiences to give them a greater potential for accomplishing real-life missions than before” (p. 73-74). The development of distributed simulations has seen great advances; however, the focus has been mostly on the development of functional features such as fidelity, mobility, scalability, and reconfigurability. Instructional functionality has received far less attention.

#### Training Approaches

The literature revealed a great deal of information about training approaches, particularly instructional strategies. Lintern (1991) defined an Instructional Strategy (IS) as “a systematic procedure for restructuring a learning environment with the goal of enhancing learning relative to that achievable with a standard mode of instruction” (p. 187). For the purposes of the present work, an **instructional strategy** is defined as: a deliberate and systematic approach for controlling the learning environment to promote training. Scenario Based Training (SBT) is one instructional strategy that provides a valuable framework for training
environments such as DMT (see Figure 2). A more thorough description of SBT is provided by Oser, Gualtieri, Cannon-Bowers, and Salas (1999).

Figure 2. Scenario Based Training Framework (Oser, Cannon-Bowers, Salas, & Dwyer, 1999)

How does SBT fit into the big picture of conducting real-world military operations? It is situated into the operational ‘big picture’ by providing an opportunity to train skills deliberately in a controlled environment. Aidman, Galanis, Manton, Vozzo, and Bonner (2002) state that “typically training is considered on a continuum between fully controlled and free play environments” (p. 171). Figure 3 depicts such a spectrum. Ideally, free play training events are very similar to live operations. Specifically, Miller and Thorpe (1995) described a free play environment as a “non-scripted setting, constrained only by the operational rules and disciplines to which they subscribed (the chain of command and its rules of engagement)” (p. 1116). Free play, then, is considered in nearly the same area of the spectrum as live combat operations. The SBT approach facilitates instructional control over an exercise and exists in the spectrum as a subset of training that is shifted toward controlled environments. SBT also affords the ability to adapt training based on lessons learned in live operations. The dotted arrow in Figure 3 represents the incorporation of lessons learned from live operations, and would enter the SBT model through the task lists component (see the SBT model in Figure 2). Finally, large-scale networked simulation systems have already been proven to provide value to units, but mainly through practice alone. Practice is useful for maintaining skills and knowledge, but valid skill and knowledge acquisition requires more than simply practice. SBT is a successful training approach which could further enhance large-scale simulations.

Figure 3. Operational Spectrum

Control
A great deal of control over training is afforded by simulation. Bell (1999) stated that “simulations can be controlled – the characteristics of the training scenarios, situational cues, and decision outcomes can be provided as aids in the development of situational awareness, pattern recognition, and template building” (p. 75). By affording increased control, simulations are well suited as training support tools. SBT, a “systematic instructional methodology,” complements the advanced technology available to provide enhanced training environments as described by Oser et al. (1999, p. 443). Further, they described two important facets of training: 1) “stimulus control,” or deliberate training opportunities, and 2) “structured repetition,” or the organized and deliberate presentation of learning opportunities (1999, p. 443). In particular, stimulus control addresses the “what” that is the focus of training, and structured repetition addresses “when” (structured) and “how much” (repetition) to train appropriately the “what.” The control that simulation affords, may directly facilitate the shift of large-scale networked interactive simulation systems from practice tools to training environments.

Aidman et al. (2002) describe the process of training as a closed-feedback loop. They also point out that “all training systems have... feedback as their critical element” (p. 172). It is feedback that distinguishes training from practice. Feedback is also a critical component of the SBT approach. Similarly, the instructor-system-trainee interaction may be viewed as a feedback control system (e.g., Vines & Rowland, 1995). Figure 4 illustrates the feedback relationship of monitoring and assessing trainee performance and the subsequent feedback an instructor may provide, based on the SBT model. Training scenarios contain event-based training tasks for providing training opportunities to trainees. The events, or tasks, are the input into the feedback system. If the instructor determines that any actions are necessary, he may implement them to affect what is presented to the trainee. Additionally, the
instructor may decide to provide direct instructional feedback to the trainee. Thus, the system view depicts any instructor action as a form of feedback.

Figure 4. Instructor-System-Trainee Interaction

A major challenge for training system designers is to identify ways in which a simulated training exercise can be controlled to promote training while supporting instructors by guiding the appropriate selection and arrangement of training stimuli. To accomplish this, a couple questions must be addressed: 1) What aspects of the simulation are more useful to control in order to manage training value? and 2) how and why might an instructor want to control such aspects? The present work provides an initial address of the questions presented.

DMT Work Environment

Information was derived from the literature review to improve descriptions of the work environment in which DMT instructors operate and contribute to the foundation for building instructional strategies for exercise manipulation. In particular, exercise manipulation encompasses real-time modifications to scenario objects and events for the purpose of increasing training value based on trainee performance. As stated by Meliza and Paz (1996), exercise control “includes every action taken to control the METT-T [mission, enemy, terrain (including weather), troops, and time available] situation presented to a unit at the beginning of an exercise as well as monitoring and adjusting changes in the METT-T situation during an exercise” (p. 1). Meliza and Paz (1996) pointed out that exercise control may involve the manipulation of computer generated forces (CGF) for both friendly and enemy forces, manipulation of weapons effects, and communication with units. Therefore, exercise manipulation will include all the actions involved in manipulating the METT-T objects in the scenario, and is distinct from direct, explicitly provided instruction.

Instructors are responsible for controlling the variables of the exercise (Mission, Enemy, Terrain, Troops, and Time), behaviors of Semi-Automated Forces (SAFs), and developing AAR material for use after the exercise ends. Meliza and Paz (1996) stated that some instructors are responsible for beginning the AAR as soon as 10 minutes after the exercise ends. In addition to other task demands, instructors may have to use different computers to perform their work, further increasing their workload (Meliza & Paz, 1996). The authors further identified current efforts to reduce the instructors’ workload, such as the use of more intelligent CGFs or SAFs to reduce the responsibility of instructors to perform tedious behavior control tasks. However, there are some functions that are more appropriately performed by instructors. For example, Meliza and Paz (1996) pointed out that someone expert in the training material would be able to more directly identify if a unit has broken contact with the enemy. Generally, then, it is important to recognize that some functions should be performed by instructors and should not be automated.

In distributed exercises, regardless of size, there can be many factors that the instructor must continually monitor. Consequently, instructors have indicated enduring cognitive overload while conducting simulated training events (Walwanis Nelson et al., 2003). This finding is not surprising considering that in order to monitor and assess trainee performance over the course of an exercise, instructors must contend with a large and continuing demand on their cognitive resources. For example, the manipulation may involve repositioning entities, removing or adding entities, or inserting additional information (such as through role-playing an intelligence-providing entity). Additionally, the manipulations may take several minutes and several interactions (e.g., mouse clicks) via the instructor operator interface to accomplish the necessary actions. Several factors affect the time and cognitive resources required to implement an exercise manipulation. Eitelman, Wheeler Atkinson, Stewart, Walwanis Nelson and Stiso (2005) described some of the factors, such as complexity of the manipulation, number of entities or objects involved in the manipulation, and the potential effects of the proposed manipulation.

As the size of the training audience increases, the potential for such interactions and complications increase. Further complexity can result from the variety of instructional transactions an instructor may choose in order to alleviate possible training conflicts. For example, in a training environment involving several trainees, an instructor may choose to delete a threat posed to one trainee if it might cause the scenario to end before another trainee has had any exposure to training.
events within the scenario. Additionally, the increased control afforded by simulation technology provides instructors with opportunities to increase training opportunities by adjusting training scenarios in ways that do not reduce the training value for the audience as a whole. Thus, an instructional strategy for exercise manipulation will provide a framework for alleviating training conflicts and utilizing otherwise untapped training opportunities to support training value.

Meliza and Paz (1996) also pointed out the effects of competition between exercise control and preparation for AAR on the instructor’s cognitive resources. In particular, when an instructor recognizes that a trainee behavior needs to be captured and used to make a learning point in the AAR, he must cease attending to the unfolding exercise while using the AAR tools. Two major issues arise here. First, what are ways to reduce the workload of the instructor in developing AAR material such that his time spent away from the exercise is reduced? Second, what is the most appropriate way to control and modify a scenario to support (and possibly also to prepare for) the AAR?

**State of the Practice**

**Factors**
During interviews, instructors were provided with 11 socio-technical factors which impact system complexity (see Vicente, 1999, for definitions). This portion of the interview focused on how each socio-technical factor impacts instructors’ ability to manage and control training events. Analysis revealed several themes that appeared across multiple factors. For example, ‘External Factors’ and ‘Interaction’ appeared across three socio-technical factors, and ‘Communication’ and ‘Equipment’ were identified in two socio-technical factors. The emergence of themes both within and across factors provided the initial basis for representing the DMT environment from the instructors’ perspectives.

**Exercise Manipulation**
The data revealed that during both planning and execution, instructors make manipulations to the scenario.

**What do instructors manipulate?**
Excerpts were coded to identify the types of manipulations made by the instructors. The manipulations described by instructors generally fell into one of two categories: changes to the situation or changes to the training event itself. Most of the responses indicated manipulations to the situation. The situation is comprised of several facets: threats, trainees, resources, and general characteristics of the situation, such as how much information is available, the environment, and time pressure. The training event is also comprised of several aspects, such as training opportunities and the timing of the event. The event timing involves the starting of a training event, whereas the timing of a situation involves timing of events once the training event has started.

The themes that emerged regarding what is manipulated by the NSAWC instructors, listed in descending order by the most frequent responses are: Threats and targets, Shot success, Communications, Intelligence provided to trainees, and Event timing.

The data from the non-NSAWC instructors revealed three themes, two of which overlap with the NSAWC instructors. In descending order of occurrence they are: Trainee decisions, Intelligence provided to trainees, and Threats and Targets.

**Who**
None of the data indicated that anyone other than the instructors, in either their capacity as a controller or roller player, performed manipulations.

**When**
The interviews focused on either the trainee planning period or the execution period in a training event, or both. Most often, the excerpts reflected discussion of manipulations made during the training event period of interest, as defined by the interviewers. However, sometimes instructors would indicate that they would wait to address something in the debriefing period, although the debriefing period was not addressed by the questions of the interview. From the data provided by NSAWC instructors, the points at which manipulations were made, in descending order of reported frequency, included: during the scenario execution period, the trainee planning and instructor re-planning periods, outside of a training event (such as between training audiences, and during the debrief. From the data provided by non-NSAWC instructors, only two indications of when were collected, one during execution and one during debrief.

**How**
Two themes emerged from the NSAWC responses and were also addressed by two non-NSAWC instructors. First, about half of the responses, 24, related to communications or enemy themes. The communications theme included responses that involved the use of communication media such as radios. Thirteen of the responses indicated the instructor would use the radio communications to support administration of the
manipulation. Second, seven responses from NSAWC instructors included the need to make changes to the enemy force configurations. The responses in the enemy category ranged from general approaches such as “add threats” to more specific means of manipulation such as “launch red chasers” or “insert a red between the two blues.” None of the responses included specific information about the mechanisms for adding threats or inserting enemy aircraft; however, observations provide some insight into the mechanisms currently available. During the live exercises currently conducted at NSAWC, adaptations made to the enemy force are completed by providing direction to the instructors role-playing as the enemy force (during scenario planning) or to the instructor in communication with the enemy force (during exercise control). Conversely, changes made during simulation training, such as that conducted at EWTGLANT, can be made through an instructor station or by directing an operator to make changes to the appropriate system. Finally, one instructor mentioned four times some ways in which verbal guidance might be provided to a trainee.

Why
Seven instructors, five from the NSAWC group, across 13 different questions, provided explanations of why an instructor chose a manipulation or abstained from manipulations during the exercise. Three main categories emerged from the responses: test trainees, maintain training value for a large group, and safety. First, most of the responses addressed testing the trainee. Second, instructors also indicated many times that they would make a manipulation decision based on maintaining training value. Third, safety was noted several times as the driver of a manipulation.

DISCUSSION & CONCLUSIONS
The interviews indicated that instructors manipulate an exercise as it unfolds and that they make the manipulations to: 1) maintain training value for a large group, and 2) address safety issues. The two themes provide important underpinnings for a framework that can guide the future development of instructional support tools for DMT environments.

Other components useful to building a new framework for instructional tool development were identified from the literature review. The SBT approach in particular provides a structure to connect each training experience to specific training objectives related to the needs of a training audience across several training sessions. The SBT approach also provides a context conducive to the use of tools that would support instructors in linking exercise manipulations and related training behaviors to the objectives which they support. Second, the METT-T categorization encompasses many of the elements that instructors indicated they manipulate during an exercise. From the interviews, however, it seems that this framework could be modified to relate more directly to the manipulations instructors make. For example, future research might modify the METT-T framework to encompass the “communication” that instructors often indicated as an object of their manipulation. Also, enhancing the METT-T framework and coupling it with the structure of an SBT approach would serve to provide a solid foundation, based upon both theoretical developments and authentic patterns from the field (consistent with the Woods and Christoffersen [2002] approach) for organizing and developing appropriate instructional support tools for DMT environments.

In addition to solidifying the foundation for developing instructional support tools, further research might also reveal ways in which training objectives could be made more explicit in particular scenarios. Many of the explanations for why the instructors made (or didn’t make) a particular manipulation were not related to the specific training objectives associated with the scenario. Furthermore, instructors rarely cited the training objectives when they related the purpose of the manipulation to maintaining training value for the large group. A framework for organizing the design and development of instructional support tools might provide for a direct linkage of domain-specific training objectives to recommended manipulations that could facilitate desired patterns of behavior. Also, future investigations of the expert knowledge used by instructors during exercise manipulation (e.g., in the NSAWC domain), would provide a useful complement to the present work. Such research could lead directly to the development of prototypes of instructional support
tools that could help answer questions about how best to support human performance in relation to new technologies.

Numerous ideas for possible instructor support tools were identified in the literature. For example, Bass (1994) noted that although a well-structured scenario should not require much instructor manipulation, instructors should always have the option to perform a manipulation for many valid reasons, such as providing a special demonstration or addressing remedial training. In practice, although the NSAWC instructors thoroughly plan the training scenarios, they clearly require capabilities to manipulate the training scenario as it unfolds. Importantly, the instructors should be able to manipulate the scenario such that the training value for the airwing or unit as a whole and safety can be maintained. And, as noted, useful support tools would facilitate linking manipulations to specific training goals, thereby facilitating AAR, update of skill inventories, and other analyses within a training group across time and across groups.

In addition to supporting linkages between manipulations and training objectives, other tools would support administering the manipulation. For example, some of the actions required to implement a manipulation might be automated to reduce instructor workload. Such automation tools would allow the instructor to have override control and to direct necessary changes. Manipulation support tools might provide specific cues that identify the situation in which a manipulation should be made, as noted by some of the instructors in the present study. Such manipulations are primary candidates for automation tools. However, not all manipulations may be amenable to automation because they may also require instructor collaboration. Instructors indicated for many of the manipulations that they “might” implement them. Sometimes very specific trigger conditions were provided, and the instructor would still indicate a probability of implementation instead of a definite decision to implement or not implement a manipulation. So, automation tools would benefit instructors for some types of manipulations, but not all. However, in all cases it appears that the instructor should maintain control authority. Instructors indicated that the automation currently does not have a great impact on their work. Most likely this is due to the fact that instructors are currently working in a live flight environment. Also, at least two instructors used descriptive terms such as “distracting” in their explanations of the automation. Foremost, instructional support tools should meaningfully assist instructors in carrying out their many functions, especially considering the intensity of their workload, while conducting a DMT exercise. The tools should be carefully designed so they are not “distracting” and should also support linkages between the manipulations, training objectives and automated performance measurement tools. The tools may address scenario development as well and allow instructors to pre-plan or pre-set automation tools to their preferences in support of manipulations they may want to administer during scenario execution.

The instructors indicated a size range of the groups in which they collaborate during an exercise. NSAWC instructors typically collaborate in a group of five or six instructors. In a larger exercise, such as the ones described by the Army officers, more instructors may be involved. Similarly, as the exercise itself becomes more distributed, such as multiple trainee sites linking into a common simulated battlespace, more and more instructional and support personnel are likely to be involved in addition to an increased dependence upon technology to support communication and collaboration between instructors. Thus, the complexity of performing instructional duties is exacerbated in part by the interactions among instructors that might be required. Simple manipulations may not involve numerous instructor actions to implement and may not affect the training value for other members of the training audience. However, some manipulations may require an instructor to coordinate with other instructors in order to implement them. Coordination may be especially important if the manipulation involves an enemy team tactic, or if the manipulation requires an instructor to ensure that the manipulation does not have a negative training impact on other members of the training audience, who may be managed by other instructors. The complexity of the impact of one change could be extensive, depending upon the context of the situation and the size of the training audience. Therefore, tools that could assist instructors in anticipating the potential effects of a manipulation before administering it would facilitate the maintenance of training value for the group as a whole.

Finally, standardization is an important issue in training. Bass (1994) points out that some of the features incorporated into simulation to achieve realism, such as random or pseudorandom behaviors in threat models, may reduce training value by limiting the ability to compare multiple students to the same performance standard. Another group of tools, then, might allow override of such “realism” features of the simulation if training value may be compromised. Such a tool might either simply alert an instructor to override and control the simulation or it might automatically control the simulation model. In either case, the tool could also
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note the override for later review by instructors. If a pattern of such overrides occurred, instructors might choose to adjust the scenario plan for future use.

Conclusions

The literature review provided some very useful information about the history of networked, simulation-based training, the challenges faced by DMT instructors, and some groundwork for defining a framework to develop instructional support tools for DMT environments. The review, however, revealed little information about specific strategies and tools that can support instructors and foster training value during a scenario.

From the current instructional practices investigation, a number of insights were gained about how instructors view their DMT work environment and what their current practices are for scenario manipulation. Instructors perform in a high workload environment involving a large problem space and must deal with many communication and external factors that can intercede to impact their work. The requirement to perform exercise manipulations is often linked to the need to maintain the training value and safety for the group. Of note, however, manipulations related to maintaining training value were most often not linked to explicit training objectives associated with the training event.

The present study clearly revealed the need for future research to define further instructional support tools that can prove most beneficial to DMT. Rather than developing tools on an ad hoc basis, however, a theoretical framework should be devised and used to guide future work in the area. The SBT approach and the METT-T manipulation variables were recommended as a good initial foundation for describing and addressing many of the factors that must be considered in framing a comprehensive treatment of instructor support variables and corresponding support tools. Though general in construction in order to be applicable across many DMT domains, the framework could be tailored to support the development of domain-specific tools based on training objectives identified for the particular domain. In the present study, many instructors indicated training objectives that were not explicitly defined anywhere. Such general training objectives coupled with domain specific ones would begin to specify particular needs for developing instructional support tools in DMT environments. The tools would also support identifying linkages between manipulations, training objectives and performance objectives, such as Navy Mission Essential Task List (NMETLs), to support and guide AARs. Other tools would support instructors in: 1) implementing a manipulation, such as through automation, 2) collaborating with other instructors for coordinating a manipulation, 3) predicting the effects of a manipulation, in order to avoid otherwise unforeseen negative training impact, and 4) providing standardized training to multiple trainees.

While this method yielded an initial collection of State of the Practice data, some limitations exist. Specifically, the interview was not structured to collect specific aspects of exercise manipulation. The interview protocol did not include probing questions to address the cues that instructors use and the decision making process that determines whether or not to administer a manipulation. For this reason, we are unable to determine what specific conditions might warrant exercise manipulations based on the current State of the Practice data. Future efforts should seek to expand this methodology to include these pieces of data. Finally, it is important to note that the State of the Science and State of the Practice efforts addressed within this paper were completed in conjunction with a multi-domain meta-thematic analysis. This approach provides a basic understanding of multiple domains of interest and can be used to derive design recommendations (see Wheeler Atkinson, Walwanis Nelson, Eitelman & Stewart, 2006).

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REFERENCES


