Adaptive Facilitation Skills for Army Instructors

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ABSTRACT

Given diverse learning populations, to increase the efficiency and effectiveness of training, instructors must meet individual student needs and deliver customized training at the point of need (Martin, 2015). The process of adapting instruction is not a trivial challenge and places many demands on instructors. Given the learner-centric approach described in the U.S. Army Learning Concept for Training and Education 2020-2040 (U.S. Department of the Army, 2017), the Army is one of the many organizations attempting to meet this challenge. Although the majority of Army instructors attend the Foundation Instructor/Facilitator Course (FIFC) and learn a variety of instructional techniques, additional tools are needed to help instructors tailor their small group instruction to the individual Soldier. Compounding the issue, instructors often face schedule, time, and resource constraints, as well as understaffing. Thus, instructors may struggle to adopt a learner-centric approach that facilitates career-long learning. This paper showcases a multi-phase process through which a tool was iteratively developed to help instructors meet these challenges. Army instructors within the Abrams Tank Maintenance Advanced Individual Training (AIT) program served as a use case for investigating how instructors recognize and diagnose individual learner problems, and adaptively employ instructional techniques in near real-time to correct those problems. Following a thorough review of academic and military literature, extensive quantitative and qualitative data were gathered through a series of observations, surveys, and knowledge elicitation sessions with instructors and students. These data helped to pinpoint top challenges students face in the course, associated observable student behaviors, diagnostic techniques, and recommended instructional strategies. Finally, findings from an empirical evaluation study indicated that the instructional tool was found helpful, especially for brand-new or novice instructors. The full process, final tool, evaluation results, and theoretical and practical implications (including the generalizability to other contexts) are presented and discussed.

ABOUT THE AUTHORS

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INTRODUCTION

In 2011, the Army introduced the Army Learning Model (ALM) in the U.S. Army Learning Concept (ALC) for 2015 (U.S. Department of the Army, 2011) and put forth ideas for a more Soldier-centered approach to learning; those ideas were further endorsed in the recent publication of the U.S. Army Learning Concept for Training and Education 2020-2040 (U.S. Department of the Army, 2017). At the center of the ALM is the concept of adaptability in that (a) the Army must develop adaptive Soldiers; (b) training content must be adaptive such that training occurs outside of the classroom and adjusts to operational needs; and (c) content, learning methods, and technologies continuously adapt based on Soldier performance. This theme of adaptability persists within the Human Dimension strategic objectives as well, which state that Army institutions must deliver innovative solutions not only to meet needs but also in *advance* of those needs (U.S. Army Human Dimension Strategy, 2015). Thus, from a teaching and learning perspective, both the ALM and the Human Dimension strategy are advocating for instructors who continuously monitor the individual state of their students and emerging learning requirements, and proactively remediate challenges by tailoring their instructional approaches to meet those needs.

Providing individualized instruction by tailoring instructional strategies and approaches places many demands on instructors. A key challenge is identifying how to facilitate instructor performance across a range of environments so that they are able to adapt their instructional skills to meet learner needs, enabling individual Soldiers to progress on key cognitive, physical, and social dimensions. The ability to adapt instructional skills is far from a trivial challenge. Within the context of the Foundation Instructor/Facilitator Course (FIFC) and the Intermediate Facilitation Skills Course (IFSC), novice instructors become familiar with a variety of instructional techniques (e.g., lecture, demonstration, practical exercises, etc.). However, while an essential start, the process of actually adapting instruction to meet learner needs faces several organizational and instructor level challenges. These challenges include, but are not limited to, the following: (a) adapting instruction while meeting prescribed programs of instruction that specify what must be learned; (b) adapting instruction while effectively meeting complex training schedules that demand a high level of throughput with rigid constraints (e.g., rounds per Soldier, class length, designated student/instructor ratios); (c) recognizing a range of challenges that individual learners might face; (d) knowing when to apply particular instructional techniques given the social, cognitive, and physical challenges that are paramount to address; and (e) adapting instruction both in real-time/near real-time to meet challenges of individual learners, and also over longer timescales by adapting instructional techniques to meet the needs of the larger classroom.

Simply put, to help meet the intent of the ALM and the Human Dimension objectives, instructors must be able to recognize if, when, and how students are struggling, and then apply alternate techniques that help achieve complex learning goals within resource and time constraints. In other words, the instructors must progress through a *sense-assess-adapt* process to adjust their strategies and meet the needs of the students (see Figure 1). The goal of this research was to produce an interactive tool through which Army instructors can learn to *sense* if a student is having difficulties learning, *assess* what the student problem may be, and then *adapt* facilitation techniques to improve learning for the individual learner (i.e., adopt a learner-centric approach).

Grounded in learning theory (Microadaptive Teaching; Corno, 2008; Zone of Proximal Development; Vygotsky, 1978), the sense-assess-adapt framework of adaptive instruction enables instructors to address critical learning challenges and maximize the learning potential of students. Multiple cycles of sense-assess-adapt can occur at different nested levels. The two levels of interest in this work are *micro-level* and a more *macro-level*. The former is focused on real-time adaptation in relation to individual learner problems. For example, if an instructor senses that a

student has become disengaged in class, he may review what the student has accomplished so far and assess that the tasks are too difficult for that student. Then, based on that information, the instructor could adapt in real-time/near real-time by providing additional scaffolding to help that student. The macro-level is about adapting on a slightly longer time scale to potential learning problems across students at the classroom level. For example, during one block of instruction, the instructor may sense through various observable behaviors that the class is not engaged and assess that the students are struggling with the topic's relevance. The next day, the instructor could adapt the instructional strategy by providing more practical exercises to engage the students and demonstrate the relevance of the topic. In both cases, the instructor, making an assessment about student problems based on behaviors (e.g., disengagement), is adapting instructional strategies to create the right learning environment (i.e., providing more scaffolding and additional practical exercises), and then reassessing the impact of the tailored approach (thus facilitating a cyclical *sense-assess-adapt* process). The explicit focus in this research is on helping instructors adapt at the micro-level. However, macro-level adaptations may occur as a by-product of increased monitoring and assessment.

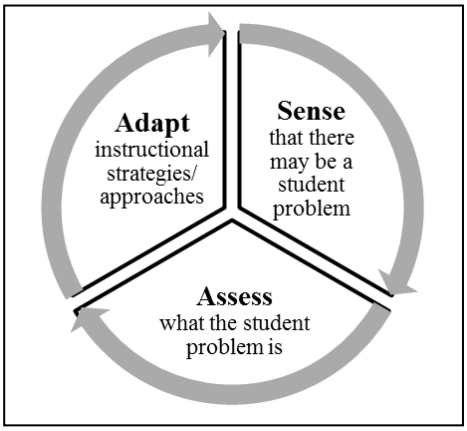

Figure 1. Adaptive Instruction Process.

USE CASE: ABRAMS TANK MAINTENANCE TRAINING COURSE

In the present study, Army instructors within the Abrams Tank Maintenance Advanced Individual Training (AIT) program served as a use case to investigate how instructors recognize and diagnose individual learner problems, and adaptively employ instructional techniques in near real-time to correct those problems. As part of an iterative development process, learner challenges and corresponding instructional strategies were identified through an academic and military literature review followed by a series of observations, surveys, and knowledge elicitation sessions with Abrams AIT instructors (including training developers and course managers) and students to gather extensive quantitative and qualitative data. These data helped to identify and narrow down top challenges students face in the course, associated observable student behaviors, diagnostic techniques, and recommended instructional strategies. An interactive tool was then developed to help instructors meet some of the challenges associated with a learner-centric instructional approach. Specifically, the tool facilitates the *sense-assess-adapt* process within instructors by providing examples of observable learner symptoms that may point to common learner challenges, and recommend techniques to help the individual students and class overcome those problems.

Although this research focused on one specific Army course (Abrams Tank Maintenance), the ultimate goal was to develop a generalizable, reusable process to help instructors in any setting tailor their instructional approaches. Therefore, while some of the identified student problems and behaviors as well as the instructional strategies are specific to the Abrams course, the overarching conceptual framework and process can generalize to other contexts. Many of the problems, behaviors, and strategies were extracted from the research literature and then tailored to the specific Abrams training course context. However, once extrapolated to a higher level, they likely are applicable to any instructional context.

To develop an interactive tool that facilitates the *sense-assess-adapt* process within instructors, a multi-phased research process was used that blends scientific literature with focus group feedback and survey data, each obtained over the course of seven independent data collections with Soldiers and civilian subject matter experts (SMEs). This research process was designed to identify the information that instructors would need at each step in their adaptation process. Three main phases comprise this research. The goal of Phase 1 was to identify common learner problems and the associated learner behaviors (i.e., enables *sensing* and *assessing*). The goal of Phase 2 was to identify effective instructional strategies and map them to the learner behaviors and problems (i.e., enables *adapting*). In Phase 3, the instructional tool was developed and evaluated.

PHASE 1: IDENTIFYING COMMON LEARNER PROBLEMS AND ASSOCIATED BEHAVIORS

Participants and Procedures

To help instructors both *sense* the presence of a learner problem and then *assess* that problem, the first step, from a research perspective, is to identify the types of learner problems that may be present. This step is closely followed by identifying the learner behaviors by which instructors may be able to recognize the presence of a problem. In the current research, Phase 1 was accomplished by first using the academic literature to identify common learner problems, and then conducting focus groups with Abrams AIT Instructors to (a) determine which problems were relevant to their specific setting; and (b) identify the associated learner behaviors.

Six domains within the education field were reviewed (i.e., student-centered instruction, learning indicators, learning inhibitors, physical environment, e-learning, and military) to obtain a baseline understanding of the types of learner problems on which research has focused. For instance, the literature on student-centered instruction identifies various instructional strategies and learner factors that may impact learning, prioritize student engagement, and enhance self-reliance and student responsibility (e.g., Crick & Goldspink, 2014; Newton, Billett, Jolly & Ockerby, 2009). Strategies are methods or activities an instructor may use to facilitate student learning (e.g., deliberate practice). Of relevance to this review is the relationship between such strategies and identified learner factors such as learners' needs, characteristics, attitudes, cognitive load, goal orientation, amount of practice, and the learning culture in the class (Platzer, Blake, & Ashford, 2000). Such factors must be considered when helping an instructor determine how to differentiate instruction to fit each student's unique needs. Example learning challenges described in the student-centered instruction literature include cognitive overload, lack of meaning-making (e.g., inability to see the bigger picture), low intelligence, low confidence in learning ability, too performance focused (e.g., focused on obtaining the right answer, not necessarily learning), and boredom.

Over 150 potential learner problems were extracted from the six literature domains that were reviewed. The list was then, with the help of SMEs, consolidated to 12 unique learner problems that were appropriate for this specific research across three categories: learning environment (e.g., ineffective communication), information processing (e.g., cognitive overload), and motivation (e.g., passiveness). An iterative cycle of three data collections with Abrams AIT instructors (n = 32, 23, and 27, respectively, with many of the same participants not only from session to session but throughout the three phases of research), each followed by data analysis and refinement, occurred to evaluate the learner problems to the research context. These first data collection sessions focused on obtaining input on the learner problems and on the relevance, severity, and frequency of learner behaviors. Over 80 unique learner behaviors were identified from the academic literature and focus groups with instructors. Following the data collections, the learner problems and behaviors were refined based on the qualitative and quantitative data obtained via knowledge elicitation sessions and surveys, respectively. The Phase 1 data collections were also simultaneously used to gather information on related learner behaviors including those that are the most likely to be encountered in select portions of the training course (e.g., hull vs. turret) or in a group vs. one-on-one setting.

Results

Full consensus was reached among participants that the most common learner issues they encounter in the course typically stem from challenges associated with four main problems: (a) anxiety, especially during direct observation of learner performance or testing; (b) comprehension of the training material; (c) confidence in an academic setting; and (d) motivation to learn or be successful in the course. The behaviors rated and ranked the most favorably on relevance, severity of impact, and frequency were retained; behaviors not necessarily rated so favorably during the survey but specifically brought up by instructors in the focus groups were also retained. Cut-off points for the ratings were used to determine behaviors that could be trimmed (i.e., under the average rating of 3 on a 5 point scale or standard deviation, *SD*, over 1). In addition, some changes were made in how the problems and behaviors were worded to ensure relevance to the Abrams AIT instructional context. The revision process above yielded a final overarching framework of four main learner problems and nine learner problem subcategories (each with 2-5 behavioral examples): *Anxiety* (Social, Academic/test), *Lack of comprehension* (Ineffective learning habits, Cognitive overload, Difficulty integrating knowledge), *Lack of confidence* (Lacks initiative, Insecure about ability to learn and perform), *Lack of motivation* (Disinterested in content/job, Discouraged).

PHASE 2: IDENTIFYING EFFECTIVE INSTRUCTIONAL STRATEGIES

Participants and Procedures

Phase 2 focused on determining how instructors can *adapt* their instructional approach based on what they learn through *sensing* and *assessing*. An iterative approach of reviewing the literature and obtaining SME feedback was used to identify relevant strategies instructors can apply in response to the learner problems identified in Phase 1. The literature review was referenced to develop an initial mapping of the learner behaviors and problems to the identified instructional strategies. Then, those strategies were down-selected through iterative reviews and data collections based on those deemed feasible for implementation in the Abrams course.

First, to generate instructional strategies and techniques that can be used to possibly remediate specific learner problems, the relevant academic and military literature relating to the four main learner problem categories (Anxiety, Comprehension, Confidence, Motivation) was reviewed. For instance, research has shown that comprehension is positively associated with performance, and failure to comprehend material likely impairs performance (Boulware-Gooden, Carreker, Thornhill, & Joshi, 2007; Rasinski, Samuels, Hiebert, Petscher, & Feller, 2011). Lack of comprehension can occur for a variety of reasons such as a poor understanding of course material, which can result from ineffective learning habits, cognitive overload, and difficulty integrating knowledge. These reasons differ considerably, as do their manifested behaviors, each requiring a different set of strategies to attenuate their negative effects. Lack of comprehension that results from ineffective learning habits, for example, may be evidenced by students having difficulty learning despite honest efforts, ineffective use of available resources, or failure to engage in active learning. These problems may be remediated by helping students understand relationships among concepts through visual representations such as graphic organizers and employ active learning techniques such as reciprocal teaching in pairs (Gregory, 2011).

Once an initial set of strategies was identified, they were mapped to specific learner problem subcategories and behaviors identified in Phase 1. Sixty-one (61) instructional strategies that could be used in the Abrams course and 32 specific recommendations (i.e., guidance on what to tell Soldiers) were extracted from the literature that addressed the four identified learner problem categories and associated subcategories. A data collection was then conducted with Abrams AIT instructors (n = 22) to (a) obtain feedback via focus groups and surveys on the relevance and feasibility of the instructional strategies derived from the literature; and (b) identify strategies that may be missing from the initial list. Interviews were also conducted with Abrams AIT students (n = 13) to validate the common learner problems and gather additional perspectives on effective instructional strategies for each of the four main learner problem categories. Feedback provided by instructors and students on specific instructional strategies for ameliorating the learner problems was used during an iterative strategy revision process.

Results

Instructor focus group feedback and survey results indicated that all instructional strategies were largely on point in terms of perceived effectiveness in mitigating the respective learner problems. The majority of the strategies were rated favorably (mean rating above 3 on a 5-point scale) across all dimensions (i.e., effectiveness, frequency of use, and ease of implementation). Certain strategies were rated relatively unfavorably due to perceived implementation difficulties relating to time and course structure constraints (e.g., difficult to deviate from prescribed assignments and lesson plans). Feedback obtained from the Abrams AIT students supported the existence of the four most common learner problem categories. Interestingly, the majority of the students indicated that any issues that may be perceived as lack of motivation likely stem from causes outside of the course itself (e.g., AIT Company-related issues such as tasks and duties in the barracks that spill over to the course). Given that the Abrams instructors have little control over non-course related issues, addressing such challenges are beyond the scope of this research.

An iterative process of instructional strategy refinement followed the data collection to enhance the specificity, relevance, and face validity of the strategies relative to the respective behavioral symptoms. Strategies identified through the data collection not previously harvested from the literature were added, and existing strategies were further contextualized to better fit the Abrams instructional context. This revision process resulted in 69 unique strategies across the four learner problems and nine learner problem subcategories (see Table 1 for examples).

Table 1. Example Instructional Strategies for Selected Learner Problems and Behaviors.

Learner Problems	Example Learner Behaviors	Example Instructional Strategy
Anxiety (Academic/Test Anxiety)	Has poor test scores compared to assignments and practical exercises	Discuss with students effective test prep and test-taking strategies (e.g., secrets of the trade, tips, best practices). Review learned topic areas and allow time for questions. Avoid last minute surprises about what will be tested.
Lack of Comprehension (Difficulty Integrating Knowledge)	Does not/slow to realize when a mistake has been made; skips over steps because used to routine	When wrong answers are provided, probe further to diagnose what students may have learned incorrectly or misunderstood. Provide a detailed explanation of correct response and refer students to the appropriate resources.
Lack of Confidence (Insecure about Ability to Learn and Perform)	Struggles to settle on an answer (goes back and forth); slow pace on exam; many corrections on paper	Build confidence through repeated drills, practical exercises, peer discussions, etc. Use same standards during practice as for the actual tests. Give students the opportunity to see any improvement (e.g., finish drills faster each time).
Lack of Motivation (Disinterested)	Has no interest in learning the material, just completing the course (stares into space; sleeps; does not ask questions)	Listen to what is driving students' dissatisfaction, and relate disappointing material to topics that matter to students (e.g., success once in unit). Have 'higher purpose' discussions (e.g., how skills learned will matter later in life). Elicit student critique and incorporate actionable input if possible.

PHASE 3.1: DEVELOPING THE INSTRUCTIONAL TOOL

Initial Mockups

Upon finalizing the learner behaviors, associated problems, and instructional strategies, an actionable set of information to help instructors *sense*, *assess*, and *adapt* had been identified. Thus, the purpose of the third research phase was to develop a tool that instructors could use to more easily progress through that cyclical process. In other words, the purpose of the tool is to provide instructors with a mechanism for identifying the most effective remedial strategies for the problems and behaviors they observe in their students. Throughout the other research phases, the research team held discussions with the leadership of the Abrams AIT course (e.g., training division directors, course managers, training developers) to determine what type of tool would not only be the most helpful to the instructors but also fit within the constraints of the course. The following constraints were identified: (a) cannot collect or store any personally identifiable information (PII); (b) any content must be capable of being edited; and (c) to enable all instructors access to the tool, must be compatible with the Army network while not requiring its own Certificate of Networthiness. Based on these constraints, the team identified the best solution as a macro-less, modifiable, Microsoft Excel-based interactive tool that can be managed and maintained internally (i.e., by designated Abrams Training personnel). An iterative research process of developing and refining the instructional tool was followed to ensure the content and workflow met the needs of the Abrams AIT instructors.

Instructional tool mockups were first developed based on initially identified needs and course constraints (see Figure 2 for sample screenshots). In this preliminary conceptualization, instructors were able to engage in several actions: (a) start a new assessment; (b) access a previous assessment for a given student; (c) reference a glossary of behaviors and strategies per overarching learner problem; (d) enter additional learner problems and applied strategies beyond those suggested in the tool; (e) export assessment data; and (f) sync up with original version stored in SharePoint. Once observed student behaviors are selected, the tool would provide the most likely cause (e.g., test anxiety) based on underlying behavior-to-problem mapping data, and then display the associated suggested strategies.

Participants and Procedures

A focus group was conducted with Abrams AIT instructors (n = 25) to demonstrate the initial tool concepts and gather feedback about the (a) mockup interface; (b) conceptual workflow and organization; (c) perceived usability and utility; (d) anything to add, delete, edit; and (e) when and how instructors might use the tool. Feedback was also

gathered on contexts in which instructors are the most likely to observe each behavior.

Results

The main feedback received from the instructors about the initial tool mockups surrounded the workflow. Specifically, the instructors expressed a desire for the tool to be simple (i.e., select a behavior based on which several instructional strategies would be displayed). Although understanding the underlying learner problem associated with the behavior was important, the instructors did not need to select from a list of problems as in the original mockups. Rather, they desired to move from behaviors to strategies directly. In addition, because of the inability to store PII and continuous data on students, there was no need to select a specific student prior to choosing behaviors. Instead, it became apparent that instructors would likely use this tool as behaviors emerge in students that they need help diagnosing. In other words, the tool would likely be most often used to help instructors in response to a specific student behavior they observed that day, as opposed to helping an instructor track and monitor behaviors over time. Finally, the feedback received during the focus groups confirmed that although more experienced instructors could benefit from the tool, the likely users would be newer instructors. This feedback was used to refine the tool content and approach.

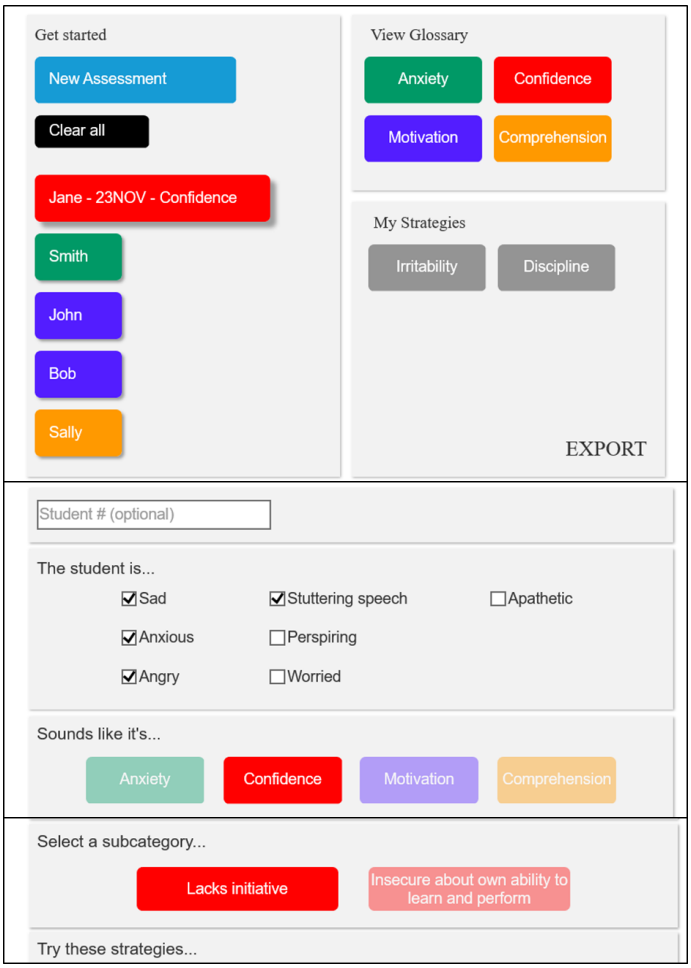

Figure 2. Initial Tool Mockups.

Tool Refinement

To help finalize and simplify the behaviors and strategies in the tool, research team members engaged in an exercise in which the effectiveness of each instructional strategy was rated in relation to each of the previously identified learner behaviors. The purpose of the mapping was to (a) ensure each strategy made sense in relation to the learner problem category with which it was grouped; and (b) gain additional data on the presumed effectiveness of each strategy to lead to a truncated list of strategies. Six research team members applied their expertise and knowledge of the domain to separately rate each strategy in relation to each learner behavior, and the data were consolidated. These data, as well as data previously obtained from the Abrams AIT instructors, were used to identify and prioritize the top instructional strategies per behavior.

As the content was being refined, the research team also reimagined the workflow and approach of the tool itself. Given the need to conform to several new requirements and constraints (e.g., compatibility with the Army network while not requiring its own Certificate of Networthiness, no collection/storage of PII,), an interactive and macro-free Microsoft Excel-based tool was developed, the content of which would be easy to manage and modify internally by designated Abrams Training personnel. Furthermore, the tool was revised such that a user would select one behavior that the student manifests, and from there, the top five recommended instructional strategies would appear. The user would also automatically obtain information on the context/setting in which that behavior is most likely to occur, as well as see the most likely root cause of the behavior (i.e., learner problem subcategory). The refined tool also contained several additional features. Namely, there is an authoring component where instructors can add notes regarding specific instructional strategies, additional behaviors they may have observed in their students, and new strategies that they have used in response to a specific behavior. The goal of the authoring tool is to ensure that the

tool is a "living document" stored on a shared drive that can continue to benefit from the expertise that the instructors possess and allow instructors to learn from the strategies that others have implemented.

PHASE 3.2: EVALUATING THE INSTRUCTIONAL TOOL

A two-phased evaluation protocol was developed to examine the utility and usability of the refined instructional tool from an end-user (i.e., instructor) and SME perspective: (1) Observations, and (2) Initial Training and Pilot. Through these phases, the objective was to evaluate the instructional tool by gathering empirical data on instructor reactions, and instructor ability to identify learner problems based on observable behaviors and then adapt instructional approaches based on recommended courses of action. Specifically, the ability of the tool to support identification and implementation of relevant strategies was evaluated. In addition, opportunities for tool enhancements were identified based on any reported usability, functionality, and efficiency issues.

Evaluation Phase 1: Course Observations

Participants and Procedures

The goal of the first phase was to obtain formative feedback on the relevance of the instructional tool content and demonstrate its value to the instructors. In this phase, four members of the research team observed key training events (i.e., those events where students typically demonstrate the most problems such as turret familiarization and testing). During the observation periods, the research team members took notes on the student behaviors and then debriefed with instructors (n = 9) to discuss these behaviors and potential underlying problems. Following the observations, the research team members reviewed the information in the tool to determine if the recommended strategies were aligned with the instructor behavior and noted potential revisions to the content. The tool was also demonstrated to members of the Abrams training course leadership team to gather additional reactions and feedback.

Results

The following feedback was obtained which resulted in further modifications to the instructional tool. First, the instructors liked the simplicity of the tool (i.e., only showing a few instructional strategies in response to a given learner problem), as well as the ability to use the tool in near real-time. They also believed that including the full strategy library in the tool would be beneficial to instructors who would like to review additional remedial strategies for a given problem. Furthermore, members of the Abrams training division leadership team demonstrated an interest in tracking how often student problems occur during one instantiation of the course. Whereas the leadership team members were interested in this tracking occurring at the class level to show overall trends, instructors were more concerned with tracking at the individual level to gather insights that would help them tailor their instructional approach to the specific needs of each student. Based on this feedback, the requested changes (i.e., full library of strategies, references and links to literature with more advanced instructional strategies, and a method for compiling and tracking observations) were implemented in to the tool prior to the second phase of evaluation.

Evaluation Phase 2: Initial Training and Pilot

Participants and Procedures

The goal of the second phase of the instructional tool evaluation was two-fold: (a) train a set of instructors (n = 10) on how to use the tool; (b) obtain usability and utility data; and (c) gather evidence of changes in instructor knowledge regarding the best strategies to use in relation to specific student problems. Three instructors were relatively novice, with fewer than five Abrams course cycles taught (tenure in current role of 8 months or less). The remainder of the instructors was relatively experienced, with at least two years tenure in current role and 12 or more cycles taught. Prior to the tool demonstration, the instructors were given a declarative knowledge assessment to gather baseline information on their familiarity with various instructional strategies (i.e., identify the most appropriate remedial strategy for a given learner problem or observed student behavior).

Following the tool demonstration, the instructors were administered a survey to obtain initial reactions toward the tool content and functionality on a 5-point scale (1 = Strongly Disagree to 5 = Strongly Agree). Example tool content items include "I think the list of behaviors is comprehensive" and "I would recommend these strategies to another instructor." Example tool functionality items include "The tool was easy to navigate" and "The interface supported my work style and workflow." The instructors were asked to share their reactions and elaborate on their

survey responses as part of a brief semi-structured interview. Following the training, the tool was distributed to the ten instructors to use as much as they were able for a period of about two weeks. At the end of this period, the instructors completed similar surveys to those completed at the end of the training; they also participated in a brief semi-structured interview to contextualize and elaborate on their survey responses.

Results

Surveys on tool utility and usability were administered to instructors before and after the pilot. Responses were positive on all accounts. Mean ratings for the abbreviated, 7-item pre-pilot tool content scale was 4.11 (*SD* = .19), and 3.77 (*SD* = .33) for the full, 13-item post-pilot tool content scale. Mean ratings for the abbreviated, 9-item pre-pilot tool functionality scale was 3.97 (*SD* = .36), and 3.69 (*SD* = .58) for the full, 20-item post-pilot tool functionality scale. Most tool usability and utility items were rated favorably (i.e., mean rating of at least 3 on a 5-point scale). The highest rated items were generally those pertaining to comprehensiveness, ease of use, and simplicity of the tool and content. Based on pre- to post-pilot percent change calculations, the pilot test appears to have solidified instructor perceptions of tool simplicity and user-friendliness. However, concerns about tool sustainability and alignment with instructor workflow appear to have become more salient post-pilot as well. Some of the lower ratings may be a result of the tool being more beneficial only at certain times within the course when students tend to experience more challenges and/or for newer instructors.

Pre- and post-pilot declarative knowledge assessment results show changes in responses for at least 20% of the items, with five instructors having changed an incorrect answer in the pre-pilot assessment to the correct answer in the post-pilot assessment. Furthermore, the assessment scores increased for three experienced instructors, decreased for three novice instructors, and remained unchanged for one novice instructor. The test was not turned in by three of the ten instructors as they were absent from the post-pilot data collection. This pattern of results points to a potential benefit to experienced instructors which is to use the tool as a self-check or refresher on possible remedial approaches. Novice instructors may need additional support (e.g., training, debriefs) to reap the benefits of the tool. The declarative knowledge assessment items, however, were developed based on the learner behavior, learner problem, and associated instructional strategy mapping generated as part of this research effort. Given that the "right" answer is highly dependent on the context and varies based on experience, the goal of the assessment was to identify trends or changes in responses after having used the tool rather than evaluating knowledge based on tool content. Clearer gains in learning may be seen over a longer period given that the tool will likely not be used daily.

During the pre-pilot test discussions (i.e., immediately following initial training), instructor feedback was minimal yet largely favorable. For example, they liked the comprehensiveness and simplicity of the tool and the user-friendly and intuitive navigation. After the pilot test, instructors again indicated that the tool content was comprehensive, easy to use, and relevant. The recommended instructional strategies, albeit elementary, also served as a good refresher for experienced instructors. As a result, the instructors requested the addition of resource links to more advanced instructional strategies for handling learner problems. Such advanced resources would help facilitate tool evolution and promote instructor development, and consequently improve tool sustainability over time.

Feedback was also gathered on workflow. Instructors indicated that they were unable to use the tool in real-time given the high pace and structural rigidity of the course. This is especially true for hands-on exercises or during testing where instructors are required to maintain uninterrupted focus on students. The instructors indicated that they were instead able to occasionally reference the tool during breaks and at the beginning or end of the day. Additionally, it was noted that the tool would be the most beneficial during critical course transitions (e.g., introduction to course, turret familiarization). While the tool could serve as a refresher and self-check for experienced instructors, it would be the most beneficial to new instructors coming into this program of instruction, especially to those with no experience being in charge of Soldiers.

Final Adaptive Instructional Tool

Following the completion of the evaluation study, the following refinements to the instructional tool were made: (a) added resources for more advanced strategies to assist experienced instructors; (b) adjusted authoring tab features to enable addition of more instructional strategies; and (c) completed development of behavior and strategy tracking tools capability. The final tool contained 29 learner behaviors indicative of a potential problem and 80 unique instructional strategies (i.e., 145 strategies with overlaps).

Embedded in the final Excel-based tool are several features including (a) *View Recommendations tab* (contains 29 learner behaviors that when selected each automatically produce the potential underlying learner problem and top five remedial strategies); (b) *Record Notes tabs* for each main portion of the Abrams AIT course (instructors can take notes about behaviors they observed, strategies that worked for them, and suggest changes to the tool content); (c) *View Library tab* that contains a list of all possible instructional strategies identified for each learner behavior as a reference guide, and (d) *View Resources tab* that contains references and links to scientific research about more advanced instructional strategies for the learner problems. Screenshots of the final tool table of contents and view recommendations tab are included in Figure 3.

In addition, separate Excel-based files were developed for the Abrams Course Manager: *Master Adaptive Instructional Tool* with authoring capability; and *Master Tracking Tool* that automatically compiles instructor notes and tallies summary data. Instructor and Course Manager User guides were provided and a final training session was conducted with end-users (n = 35).

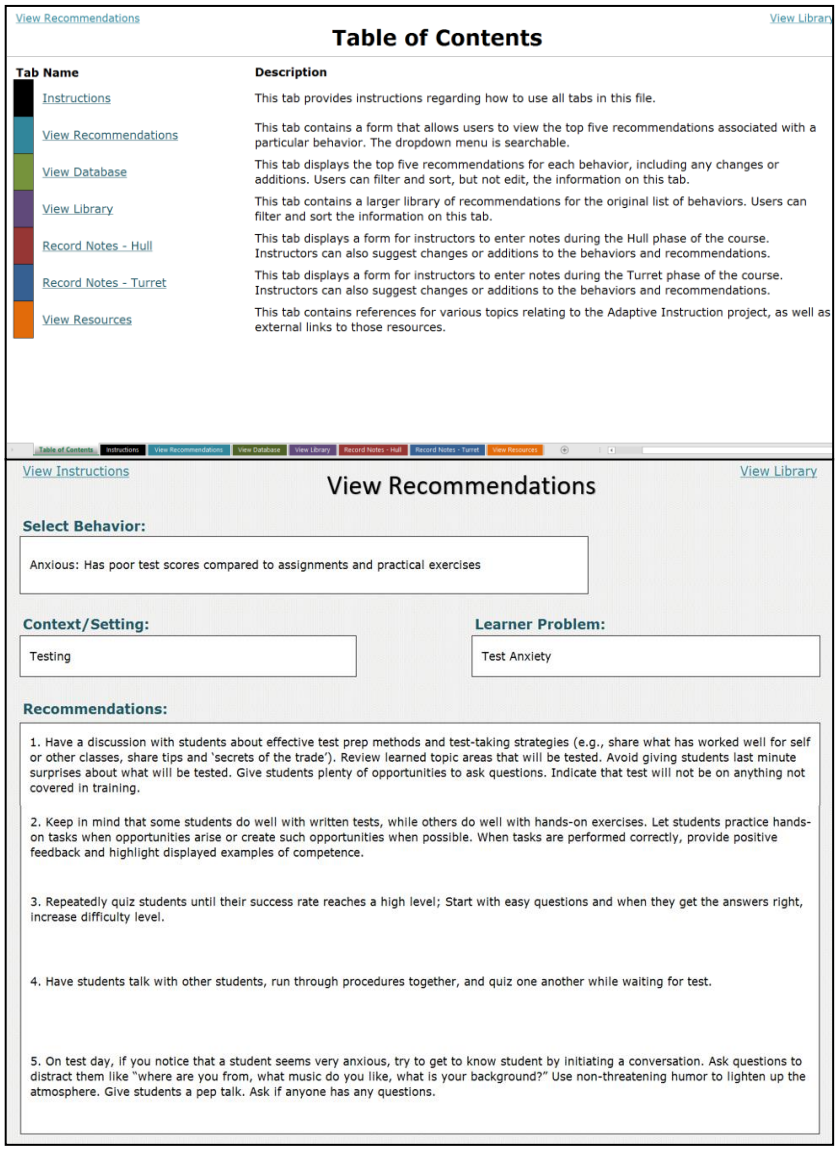

Figure 3. Final Instructional Tool.

DISCUSSION

The research presented here describes the development of an interactive instructional tool that represents one step forward in helping instructors meet some of the challenges associated with a learner-centric approach – specifically, adapting instructional strategies to the needs of individual students through a cyclical *sense-assess-adapt* process. Based on user feedback, the tool would most likely be used during breaks or at the beginning or end of the day whenever problems arise. The tool can be used proactively or reactively depending on the nature of the learner problems and associated context. Certain strategies can be applied in an effort to anticipate and prevent common mistakes or learner issues during challenging portions of the course (i.e., proactive approach). In contrast, the reactive approach is when an instructor recognizes a problem and applies an appropriate remedial strategy in response.

While the Abrams Tank Maintenance AIT instructors and students served as a use case, the research process can be reused for any instructional setting (e.g., Initial Entry Training, Officer Candidate School). The evaluation study findings indicated that the tool would be especially helpful to brand new or novice instructors, as well as enable continued professional development for experienced instructors. As such, the tool could be incorporated into the FIFC curriculum or Abrams Instructor Certification course to raise awareness about the importance of adaptive

facilitation and help instructors learn to recognize and address student problems in near real-time. To optimize use, instructors should identify an optimal workflow for using and evolving the tool. For example, instructors may study the tool in advance, and refer to it occasionally when needed during downtime. Instituting a standardized process for how to update the tool and share information and lessons learned (e.g., monthly AAR) may aid in the creation of a sustainable workflow and provide an opportunity for instructors to learn from one another.

Whereas the explicit focus of this research was on helping instructors adapt at the micro-level in a predominantly reactive manner, future research could focus on macro-level adaptations and proactive instructional approaches. Due to the strong interest in student tracking tool capabilities, a tool can also be developed to consolidate student-related notes among instructors to assist in the transition process to new instructors as students advance in the course. Lastly, given that company-related issues may contribute to the manifestation of learner problems in the Abrams course (e.g., students may appear discouraged due to a stressful event that occurred in the barracks rather course-related factors), another fruitful avenue worth pursuing in future research may be to explore company-related stressors and identify associated remedial strategies.

Opinions, interpretations, conclusions, and recommendations are those of the authors and are not necessarily endorsed by the US Army.

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