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Learning to Learn: An Interactive Multimedia Instruction Validation

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14. ABSTRACT

This research experimentally tested two tailored training instructional designs—learner- and designer-controlled—to refine and validate an existing interactive multimedia instruction (IMI) package. The IMI content focused on training early-career Army Noncommissioned Officers (NCOs) on strategies and techniques for self-directed learning. Self-directed learning is considered an essential professional development skill, supporting NCOs in their career progression. The research was executed in two phases: (a) experimental comparison of two IMI instructional designs, and (b) validation of the final version of the IMI. No statistically significant difference was found between learner-controlled instruction versus designer-controlled instruction. The learner-controlled design incorporated a diagnostic test and feedback to guide the learner in selecting topics on which to focus their efforts; the designer-controlled design provided all learners with the same sequence of topics. The final version merged features of the instructional designs based on feedback from NCOs. In the validation, NCOs enrolled in Basic Leadership Courses (BLC) courses exhibited improved pretest-training-posttest performance and increased confidence in their ability to perform the trained strategies and techniques.

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LEARNING TO LEARN: AN INTERACTIVE MULTIMEDIA INSTRUCTION VALIDATION

EXECUTIVE SUMMARY

Research Requirement:

This research evaluated the utility of two types of interactive multimedia instruction (IMI) instructional designs to enhance the acquisition and utilization of self-directed learning strategies and skills among new Noncommissioned Officers (NCOs). Previous research has found that self-directed learning skills support NCOs life-long learning and professional development (Graves, Rauchfuss, & Wisecarver, 2012). Here, we refined and validated an existing IMI (Blankenbeckler, Graves, Dlubac, & Wampler, 2016) focused on training new NCOs on self-directed learning strategies and techniques to support their professional development.

Procedure:

This research was conducted in two phases: (a) an experimental test of two IMI instructional designs, and (b) development and validation of a final version of the IMI package. We tested two IMI instructional designs focused on learner-controlled training and designer-controlled training. The learner-controlled instructional design provided learners with a diagnostic knowledge test and feedback prior to the training in order to guide them through the course content. The designer-controlled instructional design provided all learners with a sequenced course of instruction. These variations were experimentally tested with Soldiers and NCOs enrolled in Basic Leadership Courses and Advanced Leadership Courses at Fort Benning, GA, and Fort Eustis, VA. Based on the findings of the experiment, the IMI was revised into a final version that was validated with Soldiers enrolled in BLC at Fort Sill, OK.

Findings:

The results of the experimental comparison of the learner-controlled and designer-controlled IMI variations showed equivalent learning outcomes regardless of the IMI design condition. Based on these findings, and the feedback of Soldiers and NCOs who participated in the experiment, we revised the IMI package into a final version incorporating features of both instructional design variations. This final version of the IMI was validated with Soldiers enrolled in a BLC course. Findings from the validation indicated increased pretest-training-posttest performance as well as an increase in Soldiers' confidence that they could perform the strategies and techniques addressed in the training.

Utilization and Dissemination of Findings:

The results of the experiment, the validation research, and a training demo was briefed to U.S. Army Sergeants Major Academy Office of Curriculum Development and Education. The final version of the IMI and all source materials were transitioned to the U.S. Army Sergeants Major Academy in support of their training development initiatives focused on the BLC. In addition, a data sharing agreement allowed for the utilization of experimental data collected and the

instructional designs to support dissertation research by Dr. Tammy Bankus (Old Dominion University, Institute for Noncommissioned Officer Professional Development, & TRADOC G-3/5/7). This resulted in a published dissertation exploring the relationship between cognitive and workload factors and the learner-controlled and designer-controlled instructional designs (See Bankus, 2016).

LEARNING TO LEARN: AN INTERACTIVE MULTIMEDIA INSTRUCTION VALIDATION

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Introduction

Army doctrine emphasizes institutional, operational, and self-development training domains as essential to professional development and mission accomplishment (Department of the Army, 2017). Among the many specific skills Soldiers learn to be successful in the Army, learning to how to learn is among the most broadly applicable. By being able to learn on their own, Soldiers can identify and address their personal learning needs—a skill described by Knowles (1975) as self-directed learning.

Soldiers who possess self-directed learning skills may experience improved job performance and long-term professional development (Graves, Rauchfuss, & Wisecarver, 2012). In this research, we (a) evaluated the utility of two instructional designs for interactive multimedia instruction (IMI) to enhance the acquisition and utilization of self-directed learning skills among new Army Noncommissioned Officers (NCOs), and (b) used our research findings to produce a final version of IMI training to enhance early-career NCOs' self-directed learning skills.

The Context of the Research Problem

In the Army, NCOs may often be tasked with duties that they were not trained for in the schoolhouse (Graves, Rauchfuss, & Wisecarver, 2012). To be effective in these situations, NCOs must learn how to learn on their own to develop new skills. Successful NCOs tend to pick up self-directed learning skills as they progress in their careers. By the time they are senior in their careers, NCOs most likely will have developed a preferred set of individual learning strategies—i.e., those strategies and techniques that have supported their long-term success (Graves, Rauchfuss, & Wisecarver, 2012).

This research is the third in three research efforts aimed at distilling the wisdom of successful mid-career and senior NCOs into an interactive multimedia instruction (IMI) training package primarily targeting early-career NCOs (i.e., Corporals [E-4] and Sergeants [E-5]) (see Graves, Rauchfuss, & Wisecarver, 2012; Blankenbeckler, Graves, Dlubac, & Wampler, 2016). The idea is that by exposing early-career NCOs to the self-learning strategies and techniques that more senior NCOs have used effectively, early-career NCOs will be better prepared for success as career-long learners. The early-career NCOs will be aware of the various strategies and techniques that have worked for other NCOs, and may be able to identify more quickly those that work for them. NCOs may benefit early in their careers from acquiring and honing a variety of knowledge and skills to support efficient and effective self-directed learning. Moreover, having NCOs who are knowledgeable and skilled in self-directed learning supports the Army's objectives of enhancing learning in a career-long continuum and fostering the sustained personal and professional development of all Soldiers (Department of the Army, 2011).

This research draws together two earlier U.S. Army Research Institute (ARI) lines of research: (a) Tailoring Multimedia Instruction to Soldier Needs (Blankenbeckler, Graves, & Wampler, 2013; 2014; Graves, Blankenbeckler, & Wampler, 2014; Graves, Blankenbeckler, &

Wampler, 2014; Graves, Blankenbeckler, Wampler, & Roberts, 2016), and (b) Noncommissioned Officer Self-Learning Strategies (Wisecarver et al., 2012; Graves, Rauchfuss, & Wisecarver, 2012; Blankenbeckler, Graves, Dlubac, & Wampler, 2016). The IMI instructional designs applied here were drawn from the former group of research efforts, and the content of the instruction was drawn from the latter research efforts. In this research effort, we began with an already developed proof-of-concept IMI—*A Leg Up on Self-Learning: Strategies for Success*— and further refined and developed its design and content (see Blankenbeckler, Graves, Dlubac, & Wampler, 2016). We developed and experimentally compared two variations of instructional design. These two variations differed in terms of whether training progressed in a way that was more (a) lock-stepped and designer-controlled or (b) tailorable and learner-controlled. Based on the findings of the experiment, we produced a final IMI package for validation and then transition to the U.S. Army Sergeants Major Academy (Fort Bliss, TX), the Army proponent for the NCO Basic Leadership Course.

Previous Research on Noncommissioned Officer Self-Directed Learning

The general structure of the training content was derived from a research-based model of how successful NCOs learn on their own for their Army duties (see Graves, Rauchfuss, & Wisecarver, 2012). The proposed model was based on focus group interviews with 123 successful Army NCOs and a survey of 1,345 NCOs, drawn from a demographically representative sample of NCOs. The model identified five categories of strategies and techniques that NCOs have successfully applied to self-directed learning in their unique professional context. The five basic components of the model concern strategies related to: (a) having the right attitudes and motivations, (b) planning and analyzing the learning situation, (c) seeking information and resources, (d) making sense of what is being learned, and (e) evaluating learning outcomes. While not sequential, the factors in the model together describe a process with associated strategies and techniques for effective self-directed learning in an Army context (Graves, Rauchfuss, & Wisecarver, 2012).

Graves, Rauchfuss, and Wisecarver (2012) found that NCOs tend to use self-directed learning strategies in three types of situations: (a) enhancing existing skills and acquiring skills for new jobs/assignments, (b) building skills for Leader roles and promotions, and (c) pursuing personal development/achievement. Within these specific situations, NCOs discussed being aware of five themes described in the NCO self-directed learning model.

Attitudes and motivations. NCOs reported they were aware that individual characteristics contributed to their motivation to learn on their own. There were three central ideas associated with this: (a) they acknowledged that they did not know something and expressed a need to know, (b) they were open to seeking help from others to support their learning process, and (c) they felt it was important to take initiative in solving problems.

Planning and analyzing the learning situation. NCOs described managing how the self-directed learning process unfolded over time. In relation to this theme, they described (a) identifying what they needed to learn, (b) anticipating what may happen during the learning process (e.g., potential distractions), (c) establishing goals and waypoints for the learning process, and (d) establishing priorities for specific tasks and topics.

Seeking information. NCOs expressed how they prefer to identify, collect, and use information during the self-directed learning process. They described (a) liking to learn hands-on, (b) liking to be shown what right looks like, (c) using their own and others personal experience and examples, and (d) relying on different sources to get to the information they need.

Making sense of learning. NCOs indicated being aware of how they were seeking to make sense of what and how they were learning. In relation to this theme, they discussed (a) being aware of their thinking process, (b) knowing what to do when they do not understand something, (c) challenging/verifying what they know or believe, and (d) taking ownership of what they are learning, making it their own.

Evaluating learning outcomes. NCOs spoke about the need to check how well their self-directed learning process was progressing. In relation to this theme, they talked about (a) relying on the NCO network for feedback, (b) checking whether they met their goals and/or completed specified tasks, and (c) whether they are able to teach to others what they have learned.

Using the findings from the focus group interviews with NCOs, the researchers developed a questionnaire to measure NCOs' self-directed learning strategy preferences. This questionnaire was administered to 1,345 NCOs, including all ranks, civilian education levels, components, career management fields, and career intentions. Learning strategy preferences were found to vary by most of the associated demographic variables, with the greatest number of significant effects found for career intentions and career management field, and the fewest for age and level of civilian education. One of the more salient findings concerned the progressive culling of preferred strategies and techniques as NCOs progress in their careers. While senior NCOs tended to prefer a smaller subset of techniques than did earlier career NCOs, the senior NCOs showed a differentiated pattern. In other words, they did not all prefer the same subset of self-directed learning techniques, indicating that NCOs may develop individualized sets of learning preferences as they progress in their careers (Graves, Rauchfuss, & Wisecarver, 2012).

Based on these findings, a subsequent research effort produced a prototype IMI package focused on training early career NCOs on self-directed learning strategies and techniques (see Blankenbeckler, Graves, Dlubac, & Wampler, 2016). The initial NCO self-directed learning focused content was enhanced by adding resources and career-focused activities, such as a template for self-evaluation, and basic tailored-training design features (Graves, Blankenbeckler, Wampler, & Roberts, 2016). These design features were intended to support individual NCOs in identifying an approach to learning that was most effective for them. The purpose of the training was not to identify NCOs' "learning types" (i.e., auditory, visual, haptic) but instead to familiarize NCOs with a variety of concrete methods that they could apply to learning on the job.[1] Moreover, this early version of the instruction allowed NCOs to compare their self-directed learning strategy preferences to those of their peers, using findings from Graves, Rauchfuss, and Wisecarver's (2012) survey of NCOs. Reviewers of the initial prototype

[1] In September of 2014, this early exemplar of the NCO Self-Directed Learning Strategies training was transitioned to the Institute for Noncommissioned Officer Professional Development at the U.S. Army Training and Doctrine Command.

encouraged further refinements to the computer-based training to optimize its effectiveness for broader use as a resource throughout the Army.

Previous Research on Tailored-Training Instructional Designs for IMI

As part of its tailored training research program, ARI has focused on instructional designs to address the unique learning needs of particular audiences and individual Soldiers. One area of emphasis in this research program has been on IMI. Of particular interest in this research was exploring different instructional designs and content selections for differing learning needs (see Blankenbeckler, Graves, & Wampler, 2013, 2014; and Graves, Blankenbeckler, Wampler, & Roberts, 2016). For instance, by manipulating the depth and breadth of information presented, an IMI package could address learning needs related to *familiarization* (a broad, basic overview of a topic) or *core/refresher* (narrowly focused, in-depth) training. Moreover, by allowing Soldiers to navigate freely to topics within a training package, the Soldiers could focus their time learning information relevant to them individually. However, faced with a sufficiently complex organization of topics, this type of free navigation could also be confusing to Soldiers and detrimental to the learning environment.

This potential problem resulted in a third variation of IMI, one that combined both elements of familiarization and core/refresher training with a pretest and diagnostic feedback to assist Soldiers in making informed decision about how to best navigate the IMI to structure a personalized learning experience (Graves, Blankenbeckler, Wampler, & Roberts, 2016). The findings from experiments conducted with these three variations of IMI—across an unfamiliar and a familiar topic domain—indicated that Soldiers who were unfamiliar with a topic tended to benefit most from a tailored training design. Soldiers who were familiar with the topic tended to self-select topics to focus on, regardless of the IMI design variation (i.e., familiarization, core/refresher, or tailored) to which they were exposed.

The Current Research Problem

The research problem addressed here derives from findings concerning the two previous lines of research described above. We sought to extend our previous findings by testing two types of instructional designs—varying the degree of control learners have over their learning experience—using the specific content from the earlier NCO self-directed learning strategies prototype IMI. The two design variations were defined as 'designer-controlled' and 'learner-controlled.' In a designer-controlled IMI design, the learner is led sequentially through the course materials in a lock-step fashion, as predetermined by the designer of the instruction. In a learner-controlled design, however, the learner is able to navigate freely within the IMI, self-selecting from among the available topics covered by the instruction. This type of free navigation is accomplished by providing the learner with a pretest and diagnostic feedback on his or her prior understanding of the topic domain and providing recommendations for topics on which to focus his or her learning activities. Based on the findings from this initial phase of the research, we then modified further the design and content of the NCO self-learning strategies IMI. Using this final version of the IMI, we conducted a training validation with Army NCOs enrolled in a Basic Leaders Course (BLC). Figure 1 presents a diagram of the research process.

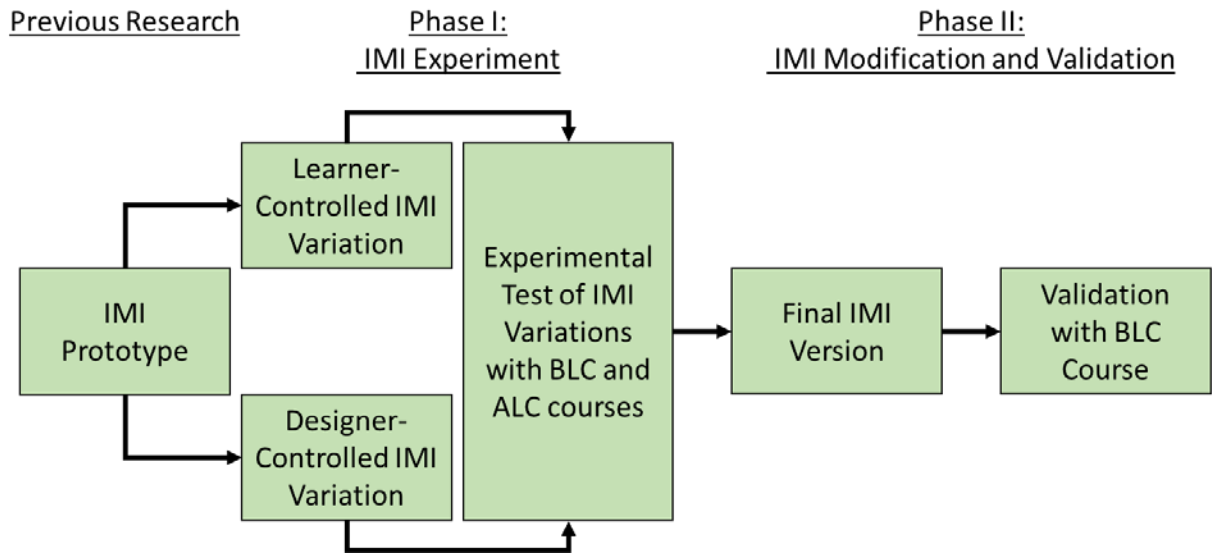

Figure 1. Diagram of the Research Process. The IMI prototype is presented in Blankenbeckler, Graves, Dlubac, and Wampler (2016).

This report describes (a) the initial IMI relook and refinement process, (b) an experiment comparing the designer- and learner-controlled variations of the IMI, (c) the subsequent modifications based on user assessments and feedback, and developer reviews, and (d) the validation of the final IMI design.

Initial IMI Refinements

The existing IMI prototype—*Getting a Leg Up on Self-Learning*—was initially refined by assuring that the content was focused on the perspective and needs of the intended audience. This enabled us to determine that the training approach and delivery would have optimal impact. In the initial research (Blankenbeckler, Graves, Dlubac, & Wampler, 2016), we had identified an audience spanning Specialists/Corporals (E-4), Sergeants (E-5), and recently promoted Staff Sergeants (E-6). This audience would seem to have the most to learn, facing an increasingly complex and challenging future, and would benefit most from refining their self-directed learning strategies and techniques.

That said, the audience who may potentially find the IMI useful also includes Leaders that are more senior. While these senior Leaders may have already identified self-directed learning strategies and techniques that are most effective for them, the IMI may serve as a tool to assist in teaching, coaching, mentoring, and developing subordinates who may express a diversity of preferred approaches to learning. A senior Leader may be able to apply a broadened understanding of learning techniques to provide guidance and support to other NCOs' self-directed learning activities. To date, the Army has lacked a training tool that bundles instruction on self-directed learning strategies and techniques with career-development resources and recommendations, specifically targeting NCOs. The IMI developed in this research contains a collection of training support materials and consolidates related materials in a way that makes them immediately accessible to the learner. This includes links to training sources and resources on the Internet and Army Knowledge Online (AKO).

Our initial review of the training materials with stakeholders at the Institute for Noncommissioned Officer Professional Development (INCOPD) indicated that the content appropriately targeted early- to mid-career NCOs, and could be used by more senior NCOs to support mentoring activities. Moreover, INCOPD felt the training materials appropriately targeted NCOs who were seeking self-improvement, learning new skills and duties, or preparing for advancement, more challenging leadership positions, and other career responsibilities. The reviewers indicated that the selected training approach and content were acceptable for the intended audience.

One issue that arose in our discussions concerned the use of synthetic voice for narration in early versions of the IMI. While a less expensive option than live narration, the synthetic voice narration tended to be metallic/breathy sounding, with halting enunciation and mispronunciations, especially of military terms and acronyms. It was determined that the synthetic voice would distract NCOs from the content of the training. The trade-off between reduced cost for development (Karrer, 2010) versus reduced extraneous processing (Mayer, 2008; 2009) indicated that a design incorporating live voice narration would improve learning outcomes. We did not want the audience to be distracted from the quality of the content due to a poor quality narration. All narrations were updated to live voice. Further, instructional topics alternated between male and female narrators to promote acceptance by a larger military audience. The voice actors practiced military terms and acronyms to enhance authenticity and improve acceptance by the target audience.

Another update to the IMI focused on a dialog between a mature battalion (BN) command sergeant major (CSM) who was providing guidance to a departing subordinate. A BN CSM would typically be aged in their 40's. His or her voice would be mature and intonation would reflect confidence gained from announcing orders to Soldiers spread across a parade field. Our review indicated that while the narration was presented correctly, the narrator sounded too youthful, i.e., the voice of someone aged in the mid- to late-20's. The voice of a more mature narrator was used for the CSM in order to better evoke principles of personalization and embodiment (Mayer, 2008; 2014), enhancing the credibility of the presentation.

Some minor revisions were identified for the text and navigation aids. These revisions improved signaling and spatial contiguity in the IMI to ease cognitive load associated with navigation, to improve readability, and to maintain learners' focus on relevant information (Mayer, 2008). These revisions included:

- Adding extra spacing on text-heavy screens,
- Adding module titles to module menu descriptions, and
- Adding indicators to menus and screens to provide additional points of reference, better conveying the user's location in the media.

When learners can interact with the media, their learning outcomes are improved by increasing their engagement with the training content (Mayer, 2008; 2014). Primarily, this is accomplished by cueing learners to essential information. These modifications included:

- Clickable images and pop-up text on five screens,
- Roll-over images to display text on five screens, and

- Text highlighting animation corresponding to audio on one page.

Enhanced cuing was also accomplished through revisions to the fidelity and appearance of some graphics. Exaggerated pauses were incorporated into a few narrations to improve emphasis on key points or to better synchronize text displays. Aside from inserting live voice narration, no major edits were required for the content of the original IMI.

Learner- versus Designer-Controlled Instructional Designs

The first version of the IMI developed was a designer-controlled courseware, with the main menu encouraging learners to progress through the training topics in the order presented, ending with a lesson summary. All learners would be presented with the same training structure and would be guided through the training with the same sequence of topics. The main menu in this version of the IMI is presented in Figure 2.

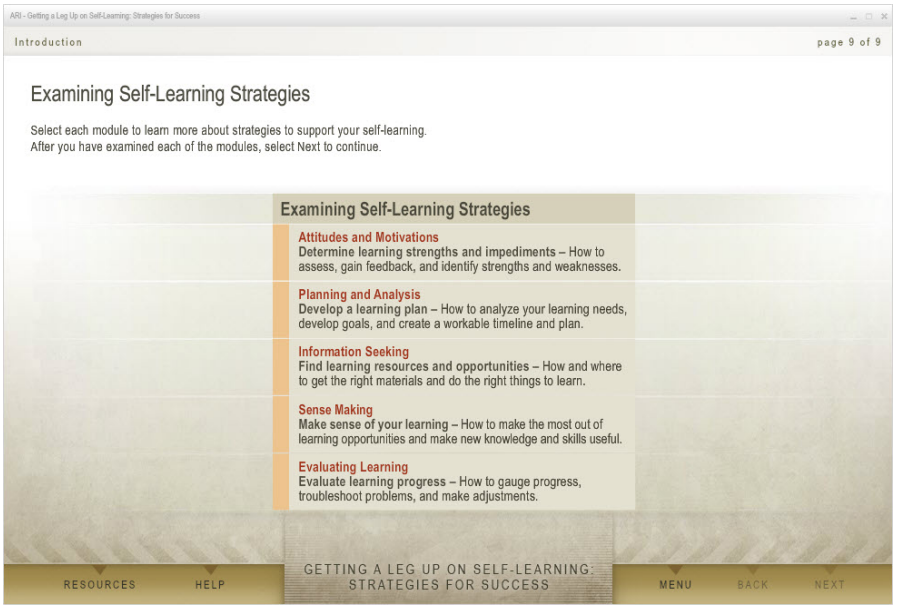

Figure 2. Main Menu for the Designer-Controlled Version of the Courseware

In contrast to the designer-controlled version of the IMI courseware, we applied various instructional design techniques from earlier research to develop a learner-controlled variation (see Graves, Blankenbeckler, Wampler, & Roberts, 2016). An 11 question pretraining assessment was developed to provide learners with diagnostic feedback and recommendations for topics to focus on in the training. Two to three questions were drawn from each of the five sections of the training. All questions were multiple choice. All but one question required multiple responses to attain a passing score for the question. Learners were able to bypass the topics for which they had attained passing scores. Figure 3 depicts the relationship between the pretraining assessment feedback and the main menu in the tailorable learner-controlled courseware. While the learner-controlled training design provided recommendations to learners concerning how they should proceed through the training, learners were still able to elect to work through all instructional topics.

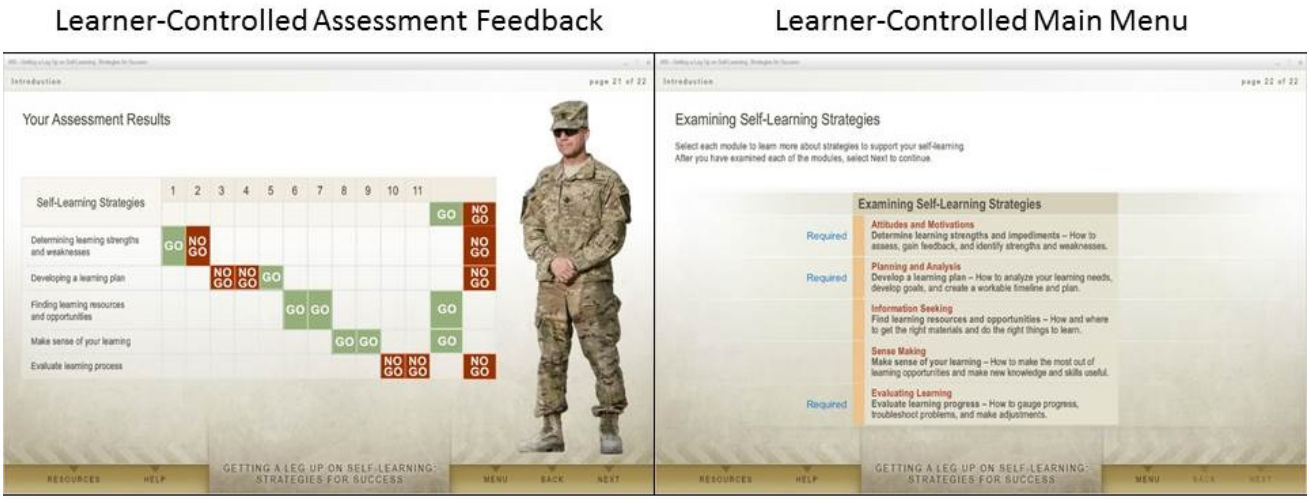

Figure 3. Pretraining Assessment Feedback and Tailored Main Menu for the Learner-Controlled Version of the Courseware

In our prior research, we found that Soldiers tended to spend more time on recommended sections of training when they received individualized feedback about their training needs (Graves, Blankenbeckler, Wampler, & Andrews, 2016). For this research, we ensured that aside from the assessment, feedback, and modified menu in the learner-controlled variation, both versions of the IMI courseware presented exactly the same instructional content.

Comparing Learner- versus Designer-Controlled IMI Variations

Soldiers enrolled in Basic Leadership Courses (BLC) at Fort Benning, GA, and Advanced Leadership Courses (ALC) at Fort Eustis, VA, participated in an experiment to compare the designer- and learner-controlled IMI variations. Data were collected with Soldiers (n = 42), primarily staff sergeants (E-6) enrolled in the Aviation Logistics ALC at the Aviation Center of Excellence NCO Academy (NCOA), Fort Eustis. Soldiers (n = 46) from four BLC classes at the Henry Caro NCOA at Fort Benning participated in the research. The BLC students ranged from Specialists and Corporals (E-4) to Sergeants (E-5), and represented a broad cross section of military occupational specialties (MOSs). As new NCOs, the BLC students were most representative of our target training audience.

Procedures

Procedures differed slightly between our data collections at Fort Eustis and at Fort Benning. At Fort Eustis, all data were collected in a single session. The ALC students were gathered in a large classroom to be briefed on the purpose for the research and on their rights as participants in research. Soldiers provided signed informed consent form. [2] Due to scheduling

[2] In addition to the data we were collecting, two additional questionnaires were being administered in support of Dr. Tammy Bankus' dissertation research with Old Dominion University. For this reason, participants were asked to sign an informed consent form to provide documentation of consent as the data they were providing were also going to be used for a non-governmental purpose. Documentation of consent was to ensure compliance with both the ARI's and ODU's institutional review boards' requirements.

issues, many within the initial pool of 80 students opted out of participation. The final number of participants was reduced to 42.

The participants were split by experimental condition between two large classrooms with desks and desktop computers, with 20 students in the designer-controlled condition and 22 in the learner-controlled condition. The NCOA allowed us to run the training software on their classroom computers, which were not connected to the Government network. The researchers provided headphones, the training software, and data collection materials. Headphones were used to reduce the distraction of the audible narration, as students progressed through the training at different rates.

At Fort Benning, four BLC classes participated in the experiment. These data collections were spaced across four weeks, with one BLC class per week, to better accommodate the BLC course schedule. Approximately 12 Soldiers participated in each session. The Soldiers were seated at desks in a small NCOA classroom, and were provided laptop computers to complete the training. The same informed consent briefing was provided to the BLC students as was provided to the ALC students, and their signed informed consent forms were collected. All Soldiers chose to participate in the research. Likewise, the same data collection materials were administered in the same order. For each data collection session, we sought to balance the number of Soldiers in each condition: 24 in the designer-controlled IMI condition, and 23 in the learner-controlled IMI condition.

During the data collection sessions, all Soldiers first completed a demographic questionnaire and were administered a pretest to assess their background knowledge and experiences concerning self-directed learning. After completing the questionnaire and pretest, Soldiers worked their way through the IMI training. When they had completed the training, they were administered a posttest to assess what they had learned from the training. Finally, Soldiers completed a questionnaire concerning their learning experience and evaluation of the IMI content and design. Additional inventories in support of a data collection for the aforementioned doctoral dissertation were administered: a measure of self-regulation and cognitive skills prior to training, and a measure of workload following training (see Bankus, 2017).

Participant Demographics

A demographic questionnaire was administered to collect data on participants' age, rank, military occupational specialty, current duty assignment, civilian and military education, self-directed learning experience, etc. The total sample consisted of 89 Soldiers, ranging in rank from Specialist/Corporal (E-4; $n = 44$), to Sergeant (E-5; $n = 31$), and Staff Sergeant (E-6; $n = 14$). Most had completed some college, but not yet completed a degree ($n = 44$). Twenty-eight MOSs were represented in the sample, with the majority of Soldiers in an 11B (Infantry; $n = 10$) or 15R (Attack Helicopter Repairer; $n = 16$) MOS. Table 1 presents detailed demographics for the participants.

Table 1

Demographic Characteristics of the Participants

Demographic Factor	**Measure** ***N* = 89**
Course	BLC *n* = 47; 53% ALC *n* = 42; 47%
Rank	SPC/CPL (E-4) *n* = 44; 49% SGT (E-5) *n* = 31; 35% SSG (E-6) *n* = 14; 16%
Age	*M* = 28.5 years *SD* = 6.5 years *Range* = 20 to 50 years
Component	Regular Army *n* = 81; 91% Army National Guard *n* = 6; 7% Army Reserve *n* = 2; 2%
Time in Current Duty Assignment	*M* = 19.0 months *SD* = 17.4 months *Range* = 0 to 84 months
Time in Previous Duty Assignment	*M* = 26.8 months *SD* = 17.8 months *Range* = 2 to 77 months
Civilian Education	High School or Equivalent *n* = 12; 13% Some College *n* = 44; 49% Associate Degree *n* = 9; 10% Some Credits Beyond Associates *n* = 10; 11% Bachelors *n* = 7; 8% Some Credits Beyond Bachelors *n* = 6; 6.7%
Current or Previous Civilian Employment	Yes *n* = 61; 68.5% No *n* = 28; 31.5%
Received Civilian Job-Related Training (Not Orientation or Guided Supervision)	Yes *n* = 31; 35% No *n* = 58; 65%
Army Structured Self-Development (SSD) and NCO Educational System Courses	SSD Level I *n* = 48; 53.9% BLC (also Warrior Leaders Course) *n* = 8; 9% ALC Common Core *n* = 24; 27% ALC *n* = 2; 2% SSD Level III *n* = 7; 8%

Overall, the participants were Regular Army Specialists/Corporals in their 20s, had previously or currently held civilian employment, and had completed some college. Most had not received additional job-related training during their civilian employment. Most had completed at least the Army Structured Self-Development Course Level I.

Results of the Comparison of IMI Variations

Pretest and Posttest Scores

The two experimental variations of the IMI were compared in terms of Soldiers learning outcomes, learning experiences, and evaluations of the content and design of the IMI. Table 2 presents the results of the pretest and posttest comparison.

Table 2
Test Means and Standard Deviations for the Learner-Controlled versus Designer-Controlled Variations

IMI Design Variation	Pretest Scores			Posttest Scores		
	Mean	***SD***	***N***	***Mean***	***SD***	***N***
Learner-Controlled	3.79	2.61	43	4.34	2.37	41
Designer-Controlled	5.30	3.01	43	5.98	2.64	41

A repeated-measures analysis of variance (ANOVA) was conducted to test whether learning outcome differed between the designer-controlled and learner-controlled IMI conditions. Findings indicated that there was a statistically significant difference in test scores between the pretest and the posttest, $F(1, 82) = 28.5$, $p < 0.001$, $\eta_p^2 = 0.26$. The partial eta-squared indicated a moderate size effect, with Soldiers' test scores after the training being significantly higher than their scores before the training. On average, the posttest score was 1.57 points higher than the pretest on a 10-point scale. There was no statistically significant interaction, however, for the two IMI variations by pretest and posttest scores, $F(1, 82) = 0.04$, $p < 0.84$, $\eta_p^2 = 0.001$. Cronbach's alpha was used to assess the reliability of the tests. The pretest had a reliability score of $\alpha = 0.77$ (10 items), and the posttest $\alpha = 0.84$ (10 items). Both reliability scores indicated that the tests were reliable for use in applied research.

An additional repeated-measures ANOVA was conducted to analyze whether Soldiers' ranks were related to their pretest and posttest performance for each of the IMI designs. There was no interaction of rank (3 levels) by IMI type (2 levels), $F(2, 78) = 0.54$, $p < 0.59$, $\eta_p^2 = 0.01$. However, there was a main effect for rank on pretest and posttest performance, $F(2, 81) = 3.84$, $p < 0.03$, $\eta_p^2 = 0.087$. Soldiers who were higher in rank exhibited the largest difference between their pretest and posttest scores. Table 3 summarizes the means and standard deviations by rank.

Table 3
Comparison of Pretest and Posttest Scores by Rank

Rank	Pretest			Posttest			$\Delta_{post\text{-}pre}$
	M	***SD***	***N***	***M***	***SD***	***N***	
SPC/CPL	4.51	2.68	41	5.39	2.76	41	0.88
SGT	3.70	2.26	30	5.57	3.09	30	1.87
SSG	3.46	2.30	13	6.54	2.50	13	3.08
Total	4.06	2.50	84	5.63	2.84	84	1.57

We also examined whether level of education differentiated Soldiers pretest and posttest performance by IMI type. There was no statistically significant interaction between level of education (up to and including associates degree vs. completed college) and IMI type, $F(1, 69) =$

0.00, $p < 0.99$, $\eta_p^2 = 0.00$. There was no main effect for level of education, $F(1, 69) = 0.33$, $p < 0.57$, $\eta_p^2 = 0.005$.

Soldiers' Learning Experiences and IMI Evaluation

Measures of Soldiers' learning experiences and evaluations of the IMI content and design were analyzed to compare between the learner-controlled and designer-controlled IMI conditions. This analysis was accomplished using a one-way ANOVA. There were two levels for the independent variable (learner-controlled IMI vs. designer-controlled IMI), and five dependent measures from an instrument developed in prior research for IMI evaluation (see Graves, Blankenbeckler, Wampler, & Andrews, 2016). These measures concerned (a) quality of learning experience, (b) quality of design and content, (c) continuity of topics, (d) credibility of examples, and (e) tracking progress.

Quality of the learning experience. A seven item scale was used to measure Soldiers' ratings of the quality of their learning experience. In particular, this factor focused on Soldiers' overall impressions of what it was like for them to train with the IMI. Soldiers were asked to rate statements on a 5-point Likert style scale (1 = Strongly Disagree; 5 = Strongly Agree). The reliability of the 7 items was $\alpha = 0.95$ for this sample. Table 4 presents the means and standard deviations for the quality of learning experience scale by IMI type.

Table 4
Means and Standard Deviations for the Quality of Learning Experience Scale by IMI Type

Item	Learner-Controlled			Designer-Controlled		
	Mean	*SD*	*N*	*Mean*	*SD*	*N*
The IMI interactively helped my learning process.	3.28	1.18	40	2.95	1.23	43
I would use this IMI to refresh my skills at a later date.	3.15	1.37	41	2.95	1.24	44
I preferred this IMI to others I have used in the past.	3.34	1.24	41	3.14	1.30	44
I feel this IMI was able to meet my individual learning needs.	3.30	1.11	40	3.14	1.15	44
I would recommend this IMI be made available to all junior NCOs.	3.34	1.13	41	3.25	1.42	44
I feel I have a better understanding of the task after completing the IMI.	3.32	1.19	41	3.32	1.22	44
On the basis of this IMI, I could execute the task on the job.	3.24	1.20	41	3.37	1.27	43
Total	3.26	1.03	41	3.14	1.10	44

A one-way ANOVA was used to test whether Soldiers in the Designer-Controlled IMI condition and those in the Learner-Controlled IMI condition rated their learning experiences differently. There was no statistically significant difference found between the two IMI conditions, $F(1, 83) = 0.262$, $p = 0.61$, $\eta_p^2 = 0.003$. The largest difference in means between learner-controlled and designer-controlled IMI was for the item 'The IMI interactively helped my learning process,' and the smallest difference was for the item 'On the basis of this IMI, I could execute the task on the job.'

Quality of design and content. An eight item scale was used to measure Soldiers' ratings of the quality of the IMI design and instructional content. This factor focused on Soldiers impressions of the design features of the IMI and the content presented. Soldiers were asked to rate each statement on a 5-point Likert style scale (1 = Strongly Disagree; 5 = Strongly Agree).

The reliability for this set of eight items was $\alpha = 0.89$ for this sample. Table 5 presents the means and standard deviations for the quality of design and content scale by IMI type.

Table 5
Means and Standard Deviations for the Quality of Design and Content Scale by IMI Type

Item	Learner-Controlled			Designer-Controlled		
	Mean	***SD***	***N***	***Mean***	***SD***	***N***
The displays on the screen were clear and legible.	4.24	0.70	41	4.25	0.84	44
The graphics supported the material being presented.	4.10	0.77	41	3.85	1.15	44
Prompts and cues in the IMI assisted me in navigating through the material.	4.10	0.74	41	4.02	0.99	44
The information presented seemed accurate and doctrinally correct.	4.02	0.79	41	4.18	0.81	44
I felt like I was in control of my learning process.	3.78	0.99	40	3.82	1.04	44
The information presented seemed up-to-date.	3.98	0.97	41	4.05	0.91	44
I could easily track where I was in the IMI.	3.95	0.95	41	3.77	1.12	44
Uniforms, practices, and equipment were up to date.	3.68	1.15	41	3.77	1.01	44
Total	3.97	0.67	41	3.97	0.75	44

A one-way ANOVA was conducted to test whether Soldiers' ratings of the quality of design and content varied between the two IMI type conditions. Given the means for both IMI types were the same, there was no statistically significant difference between the two IMI variations, F (1, 83) = 0.0, $p = 0.99$, $\eta_p^2 = 0.00$.

Continuity of topics. The continuity of topics scale was used to measure Soldiers' impressions of the clarity of transitions between topics in the IMI. In other words, this factor addresses whether the Soldiers perceived the content to be organized coherently or to be disjointed. This factor is intended to give some insight into Soldiers' ability to formulate a mental model to guide their learning as they progressed through the IMI. Soldiers were asked to rate each statement on a 5-point Likert style scale (1 = Strongly Disagree; 5 = Strongly Agree). The reliability of the five item scale was $\alpha = 0.91$. Table 6 presents the means and standard deviations for each item on the scale by IMI type.

Table 6
Means and Standard Deviations for the Continuity of Topics Scale by IMI Type

Item	Learner-Controlled			Designer-Controlled		
	Mean	***SD***	***N***	***Mean***	***SD***	***N***
There was a clear connection between the topics.	3.80	0.98	41	4.02	0.85	44
The sequence of topics seemed to build on each other.	3.85	0.82	41	4.02	0.93	44
IMI content was grouped to facilitate learning.	3.88	0.71	41	3.84	0.99	44
There was a clear focus of topics in the IMI.	3.93	0.72	41	4.00	0.89	44
Grouping of content allowed me flexibility in accessing material.	3.90	0.80	41	3.91	0.91	44
Total	3.87	0.69	41	3.96	0.78	44

A one-way ANOVA was conducted to test whether Soldiers' ratings of the continuity of topics varied between the two IMI type conditions. Given the means for both IMI types were similar, there was no statistically significant difference between the two IMI variations, F (1, 83) = 0.29, $p = 0.59$, $\eta_p^2 = 0.003$.

Credibility of examples. The credibility of examples factor focused on Soldiers' perceptions of the accuracy and usefulness of examples presented in the IMI. Soldiers were asked to rate each statement on a 5-point Likert style scale (1 = Strongly Disagree; 5 = Strongly Agree). The reliability of the four item scale was $\alpha = 0.88$. Table 7 presents the means and standard deviations for each item on the credibility of examples scale by IMI type.

Table 7
Means and Standard Deviations for the Credibility of Examples Scale by IMI Type

Item	Learner-Controlled			Designer-Controlled		
	Mean	***SD***	***N***	***Mean***	***SD***	***N***
Examples contributed to my learning.	3.54	1.16	41	3.61	1.13	44
The examples made sense.	3.63	0.95	40	3.93	0.95	44
I learned a lot about the task from the examples.	3.59	1.07	41	3.45	1.21	44
Examples were presented in a realistic Army context.	3.66	0.85	41	3.80	0.93	44
Repetition of examples was helpful.	3.44	1.00	41	3.55	1.11	44
Total	3.55	0.84	41	3.67	0.89	44

A one-way ANOVA was conducted to test whether Soldiers' ratings of the credibility of examples varied between the two IMI type conditions. Given the means for both IMI types were similar, there was no statistically significant difference between the two IMI variations, F (1, 83) = 0.39, $p = 0.54$, $\eta_p^2 = 0.005$.

Focus and relevance. The focus and relevance scale measured Soldiers' perceptions of the focus and relevance of the IMI content, i.e., did the information and order of presentation in the IMI stay on track. Soldiers were asked to rate each statement on a 5-point Likert style scale (1 = Strongly Disagree; 5 = Strongly Agree). There were four items measuring this factor, with a reliability of $\alpha = 0.82$. Table 8 presents the means and standard deviations for each item on the scale by IMI type.

Table 8
Means and Standard Deviations for the Focus and Relevance Scale by IMI Type

Item	Learner-Controlled			Designer-Controlled		
	Mean	***SD***	***N***	***Mean***	***SD***	***N***
Sections of the IMI were of the right length to allow me to complete them without needing a break.	3.65	1.08	40	3.33	1.13	44
Questions asked within the IMI were reasonable and helped me to understand the topic.	3.83	0.78	40	3.84	1.13	44
The questions asked within the IMI focused on what was being taught.	3.93	0.75	41	3.98	0.88	44
The overall focus of the IMI was right on target.	3.68	0.99	41	3.75	0.92	44
Total	3.73	0.78	41	3.68	0.86	44

A one-way ANOVA was conducted to test whether Soldiers' ratings of the credibility of examples varied between the two IMI type conditions. There was no statistically significant difference between the two IMI variations, F (1, 83) = 0.06, $p = 0.81$, $\eta_p^2 = 0.001$.

Tracking progress. A single question was used to measure Soldiers' perceived ability to keep track of how well they would be able to suspend and resume training with the IMI. Due to

the many demands competing for NCOs' attention, we felt this question should be asked in order to assess the viability of using the IMI in an on-the-job context. Soldiers were asked to rate the statement on a 5-point Likert style scale: "If I took a break during the learning process, I could easily resume learning when I returned." A one-way ANOVA was used to compare scores on the tracking progress item in terms of the two IMI variations, and indicated a statistically significant difference, F (1, 83) = 6.22, p = 0.015, η_p^2 = 0.07. This was a small to medium sized effect favoring the designer-controlled IMI design (M = 4.11, SD = 0.87, N = 44) over the learner-controlled IMI design (M = 3.65, SD = 1.03, N = 40).

Soldier Feedback on the Two Versions of the IMI

Given that there was no statistically significant difference in terms of Soldiers' performance outcomes or ratings of the IMI, with the exception of the tracking progress item, we opted to rely on Soldiers' written and verbal comments as well as our observations during the training sessions to develop plans for the final version of the IMI. A number of comments concerned the conditions of the experiment: "too late in the day," "do this when Soldiers are fresh." Others commented on what they perceived to be the Army's overreliance on online training: "I have not seen success with computer administered courses," or "NCOs in our history did not learn from computer programs and PowerPoints." Specific actionable comments on the IMI design and content included:

- Change the length; make it shorter.
- Include checks on learning; self-assessment throughout the instruction.

During our observations, we also noted that a small number of Soldiers advanced to the end of the IMI without receiving any training by mistakenly clicking next on a critical navigation screen. This and other observed navigation errors were identified for correction in the final version of the IMI.

The feedback we received provided input for further refinement of the IMI. We merged features of both the learner-controlled and designer-controlled versions to produce the final version of the IMI for validation. While a number of NCOs had completed some college courses or earned degrees, especially the more senior NCOs, a number reported that they had not considered in-depth the focused strategies and skills required for self-directed learning. Most had only experiences in a structured learning environment, guided by an instructor and a syllabus. For these reasons, the embedded diagnostic assessment in the training was retained to support knowledgeable users in bypassing topics in which they were already proficient, focusing their limited training time on topics about which they were less knowledgeable.

Continued Refinement of the IMI

Our analysis of the user feedback and subsequent discussions among the research team allowed us to identify specific changes for the final version of the IMI, which we would use for the validation phase of the research effort. These changes included:

Enabling navigation functions of NEXT and BACK on all frames, including menu frames. This change permitted informed learners to more rapidly navigate, as well as supported

all users in moving readily through the materials. Additionally, this feature permitted learners to advance at their own pace or go back, repeat, and review materials for greater clarity or understanding.

Visited-state indicators were added, as green check marks, on the Main Menu and subtopic menus. The markers enabled learners to track what sections of the IMI they had completed, facilitating them in tracking progress and determining their location in the courseware.

Embedded resources were better identified. Soldier feedback indicated that many did not explore the embedded learning resources. Others requested information on some of the links and/or requested copies of the courseware to gain later access to the resources. An explanation of the Resources tab and content was moved to the second frame, early in the presentation.

Added multiple options for study and review. When learning with IMI, Soldiers tend to have varied paces, interests, and approaches. By broadening the options for study and review Soldiers are better able to individualize their learning experience, as either first time users or returning users. These controls were positioned early in the courseware. These navigation options provided for:

- **Begin Lesson Introduction** under the **First Time User** label
- Under the **Returning User** label, the user could select:
  - **Start Over**
  - **Return to Previous Bookmark**
  - **Go to Main Menu**

Users could also select MENU from the navigation bar to go to the lesson menu.

Added Clear Tracking Data button. This button allows users to purge cached data. If multiple users are completing training on the same computer, each user can reset the session.

Think ahead questions added throughout lessons. Think ahead questions were added to increase engagement and interactivity. These questions were used to introduce new topics, challenge user's thinking, or demonstrate applications of new concepts. Feedback is triggered when a user submits their response to a question. Feedback includes the user's response, the correct response, and explanations of the correct and potentially incorrect responses.

A number of features from the earlier versions of the software were retained. These included:

Mentor selection. Reinforcing the social nature of learning in small units, the learner selects from among three NCOs to serve as a mentor. The selected mentor introduces some topics and intervenes at points for clarification or emphasis.

Introductory scenarios. Each module is introduced with a realistic scenario that presents common challenges associated with its central theme. The scenarios were selected to be

relatable for early-career NCOs, and to help learners to see how the skills presented may be applied on the job.

Self-assessments. Self-assessments at the start of each module assist learners in assessing their attitudes and preferences regarding self-directed learning. Even without being formally exposed to training on self-directed learning strategies, a number of learners may recognize that they apply some of the techniques. These assessments allow learners to compare their own preferences to those of other NCOs by career management fields, ranks, time in service, and levels of civilian education.

Extensive use of familiar examples and metaphors. Familiar metaphors and examples are used throughout the training to explain essential concepts for self-directed learning. The familiarity of these metaphors and examples is intended to serve as memory cues and a foundation on which to build NCOs' understanding of self-directed learning knowledge and skills. Examples are drawn from common Soldiering tasks including basic rifle marksmanship, land navigation, rappelling, and other skills trained in Basic Combat Training to Initial Entry Training Soldiers.

Resources. An extensive library of official and unofficial resources were reviewed and compiled for this release. These include 18 embedded, both official and unofficial, documents and publications. These documents and publications span from Veterans Administration benefits publications for education, goal formulation documents, to methods for computing enlisted promotion points. A full array of official sites, a total of 11, provide information from links to Army Career Tracker to the Service members' Opportunity Colleges that deliver associate and bachelor's degrees to service members and their families to assure transferable credits. Finally, five unofficial sites cover topics including how to develop and use study guides to concept diagrams and mind maps.[3]

Care was taken in the selection of images, development of situations and examples, and the casting of mentors to present NCOs and Soldiers as members of the profession of arms. This included ensuring that haircuts and hairstyles were within regulations, no tattoos were visible, and uniforms were worn correctly. Images and mentors were selected to present a diverse group of Soldiers by race, gender, and ethnicity to mirror the composition of the Army. Senior-subordinate relationships were depicted in a proper manner, avoiding any suggestion of a deprecating relationship or exchange. While instances of subtle humor are evident, those instances depict true-to-life situations or use common metaphors, and avoided coarseness or impropriety. In our selection of media, we took great care to present the U.S. Army, the NCO Corps, and associated civilian personnel in a positive and professional way.

[3] A more detailed explanation of techniques, examples, and relationships can be found in ARI Research Product 2016-05, *Interactive Multimedia Instruction for Self-Directed Learning Techniques* (Blankenbeckler, Graves, Dlubac, & Wampler, 2016).

Validation of the Final Version of the IMI

After completing all final revisions to the IMI, the training package was validated with 25 Soldiers enrolled in the BLC at the NCOA at Fort Sill, OK. The Soldiers were Specialists/Corporals (E-4) and Sergeants (E-5), and represented a variety of MOSs.

Procedures

Over a two-day period, three BLC classes conducted training with the final IMI package in an NCOA classroom. The classroom was sufficiently large for each group of Soldiers to be seated comfortably at a laptop computer, with space to write. Headphones were provided so that the IMI narration from other stations would not be distracting as each Soldier progressed through the training at a different pace and sequence. The first two sessions each had 10 Soldiers; the third and final session consisted of 5 Soldiers. The sessions were conducted during the administrative days at the end of the BLC course prior to graduation, during normal workday hours.

When Soldiers arrived for the training and data collection session, they were informed about the purpose of the research and their rights as participants in research. Although Soldiers were provided an informed consent form, no signatures were collected because the research did not involve collection of personally identifying information. Soldiers were told they could indicate their consent to participate through their continued participation, and that they could decline to answer any question they did not want to answer or rescind their consent to participate at any time without penalty. One Soldier respectfully declined to participate in the data collection due to a scheduling conflict.

Soldiers were first administered a questionnaire that collected basic demographic information. Following this, they were administered a pretraining test of their background knowledge concerning self-directed learning strategies and techniques. When they had completed the pretraining test, they began the training session with the IMI. After completing the training with the IMI, they were administered a posttest of their knowledge, similar in format and content to the pretraining test. They then completed an evaluation of their learning experience with the IMI, and a self-evaluation asking them to rate their confidence before and after training in performing the various self-directed learning techniques addressed in the IMI.

Participant Demographics

A demographic questionnaire was administered to collect data on participants' age, rank, military occupational specialty, current duty assignment, civilian and military education, self-directed learning experience, etc. The total sample consisted of 25 Soldiers, ranging in rank from Specialist/Corporal (E-4; $n = 24$) to Sergeant (E-5; $n = 1$). Most had completed some college, but not yet completed a degree ($n = 18$). Thirteen MOSs were represented in the sample, with the majority of Soldiers in an 13M (Multiple Launch Rocket System Crewmember; $n = 5$) or 13P (Multiple Launch Rocket System Operations/Fire Detection Specialist; $n = 5$) MOS. Table 9 presents detailed demographics for the participants.

Table 9
Demographic Characteristics of the Participants

Demographic Factor	Measure
Course	BLC *N* = 25; 100%
Rank	SPC/CPL (E-4) *n* = 24; 96% SGT (E-5) *n* = 1; 4%
Age	*M* = 22.5 years *SD* = 2.1 years *Range* = 20 to 29 years
Component	Regular Army *n* = 24; 96% Army National Guard *n* = 0; 0% Army Reserve *n* = 1; 4%
Time in Current Duty Assignment	*M* = 14.7 months *SD* = 11.4 months *Range* = 1 to 36 months
Time in Previous Duty Assignment (*n* = 17 reported a previous assignment)	*M* = 19.6 months *SD* = 14.6 months *Range* = 5 to 54 months
Civilian Education	High School or Equivalent *n* = 5; 20% Some College *n* = 18; 72% Associate Degree *n* = 0; 0% Some Credits Beyond Associates *n* = 1; 4% Bachelors *n* = 0; 0% Some Credits Beyond Bachelors *n* = 0; 0% Master's Degree *n* = 1; 4%
Current or Previous Civilian Employment	Yes *n* = 19; 76.0% No *n* = 6; 24.0%
Received Civilian Job-Related Training (Not Orientation or Guided Supervision)	Yes *n* = 6; 24.0% No *n* = 19; 76.0%
Army Structured Self-Development (SSD) and NCO Educational System Courses	SSD Level I *n* = 10; 40.0% BLC (also Warrior Leaders Course) *n* = 15; 60.0%

Overall, the participants were Regular Army Specialists/Corporals in their early 20s, had previously or currently held civilian employment, and had completed some college. Most had not received additional job-related training during their civilian employment. Most had completed the Army Structured Self-Development Course Level I and the BLC course.

Results of the IMI Validation

Pretest and Posttest Scores

Soldiers were administered knowledge tests before and after training with the final version of the NCO Self-Learning Strategies IMI. Table 10 presents the results of the pretest and posttest comparison.

Table 10
Pretest and Posttest Means and Standard Deviations for the Final Version of the IMI

	Mean	***SD***	***N***
Pretest	4.60	2.41	25
Posttest	6.50	2.25	25

A repeated-measures analysis of variance (ANOVA) was conducted to test whether scores differed between the pretest and posttest. Findings indicated that there was a statistically significant difference in scores between the pretest and the posttest, $F(1, 23) = 11.69$, $p = 0.002$, $\eta_p^2 = 0.34$. The partial eta-squared indicated a moderate size effect, with Soldiers' test scores after the training statistically being significantly higher than their scores before the training. On average, the posttest score was 1.90 points higher than the pretest on a 10-point scale. The pretest had a reliability score of $\alpha = 0.67$ (10 items), and the posttest $\alpha = 0.74$ (10 items). Although not optimal, the reliability scores for pretests and posttests indicated that they were reliable for use in applied research.

Soldiers' Learning Experiences and IMI Evaluation

Measures of Soldiers' learning experiences and evaluations of the IMI content and design were calculated for the final version of the IMI. Five measures were used for the analysis based on an instrument developed in prior research for IMI evaluation (see Graves, Blankenbeckler, Wampler, & Andrews, 2016). These five measures concern (a) quality of learning experience, (b) quality of design and content, (c) continuity of topics, (d) credibility of examples, and (e) tracking progress.

Quality of the learning experience. A seven item scale was used to measure Soldiers' ratings of the quality of their learning experience. In particular, this factor focused on Soldiers' overall impressions of what it was like for them to train with the IMI. Soldiers were asked to rate statements on a 5-point Likert style scale (1 = Strongly Disagree; 5 = Strongly Agree). The reliability of the 7 items was $\alpha = 0.86$ for this sample. Table 11 presents the means and standard deviations for the quality of learning experience scale by IMI type.

Table 11
Means and Standard Deviations for the Quality of Learning Experience Scale

Item	*Mean*	*SD*	*N*
I would recommend this IMI be made available to all junior NCOs.	3.84	0.80	25
I would use this IMI to refresh my skills at a later date.	3.72	0.74	25
On the basis of this IMI, I could execute the task on the job.	3.72	0.68	25
I feel this IMI was able to meet my individual learning needs.	3.60	0.71	25
I feel I have a better understanding of the task after completing the IMI.	3.56	0.77	25
The IMI interactively helped my learning process.	3.52	1.08	25
I preferred this IMI to others I have used in the past.	3.28	0.94	25
Total	3.61	0.61	25

This highest ranked items for the quality of learning experience scale concerned (a) making the IMI available to all junior NCOs, (b) using the IMI at a later date to refresh skills, and (c) being able to use the IMI to learn to execute self-directed learning tasks on the job.

Quality of design and content. An eight item scale was used to measure Soldiers' ratings of the quality of the IMI design and instructional content. This factor focused on Soldiers impressions of the design features of the IMI and the content presented. Soldiers were asked to rate each statement on a 5-point Likert style scale (1 = Strongly Disagree; 5 = Strongly Agree). The reliability for this set of eight items was $\alpha = 0.91$ for this sample. Table 12 presents the means and standard deviations for the quality of design and content scale by IMI type.

Table 12
Means and Standard Deviations for the Quality of Design and Content Scale

Item	*Mean*	*SD*	*N*
The displays on the screen were clear and legible.	4.24	0.66	25
The graphics supported the material being presented.	4.12	0.73	25
Prompts and cues in the IMI assisted me in navigating through the material.	3.96	0.89	25
The information presented seemed accurate and doctrinally correct.	4.16	0.75	25
I felt like I was in control of my learning process.	4.28	0.79	25
The information presented seemed up-to-date.	4.00	0.76	25
I could easily track where I was in the IMI.	3.88	0.97	25
Uniforms, practices, and equipment were up to date.	3.72	1.14	25
Total	4.05	0.66	25

Continuity of topics. The continuity of topics scale was used to measure Soldiers' impressions of the clarity of transitions between topics in the IMI. In other words, this factor addresses whether the Soldiers perceived the content to be organized coherently or to be disjointed. This factor is intended to give some insight into Soldiers ability to formulate a mental model to guide their learning as they progressed through the IMI. Soldiers were asked to rate each statement on a 5-point Likert style scale (1 = Strongly Disagree; 5 = Strongly Agree). The reliability of the five item scale was $\alpha = 0.82$. Table 13 presents the means and standard deviations for each item on the scale by IMI type.

Table 13
Means and Standard Deviations for the Continuity of Topics Scale

Item	*Mean*	*SD*	*N*
There was a clear connection between the topics.	3.84	0.80	25
The sequence of topics seemed to build on each other.	3.96	0.73	25
IMI content was grouped to facilitate learning.	4.08	0.64	25
There was a clear focus of topics in the IMI.	4.08	0.64	25
Grouping of content allowed me flexibility in accessing material.	4.12	0.60	25
Total	4.02	0.60	25

Credibility of examples. The credibility of examples factor focused on Soldiers' impressions of the usefulness of the examples presented in the IMI. Soldiers were asked to rate each statement on a 5-point Likert style scale (1 = Strongly Disagree; 5 = Strongly Agree). The reliability of the four item scale was $\alpha = 0.81$. Table 14 presents the means and standard deviations for each item on the credibility of examples scale by IMI type.

Table 14
Means and Standard Deviations for the Credibility of Examples Scale

Item	*Mean*	*SD*	*N*
Examples contributed to my learning.	4.00	0.65	25
The examples made sense.	4.16	0.62	25
I learned a lot about the task from the examples.	3.80	0.87	25
Examples were presented in a realistic Army context.	3.76	0.72	25
Repetition of examples was helpful.	3.64	0.76	25
Total	3.87	0.55	25

Focus and relevance. The focus and relevance scale measured Soldiers' perceptions of the focus and relevance of the IMI content, i.e., did the information and order of presentation in the IMI stay on track. Soldiers were asked to rate each statement on a 5-point Likert style scale (1 = Strongly Disagree; 5 = Strongly Agree). There were four items measuring this factor, with a reliability of $\alpha = 0.76$. Table 15 presents the means and standard deviations for each item on the scale by IMI type.

Table 15
Means and Standard Deviations for the Focus and Relevance Scale

Item	*Mean*	*SD*	*N*
Sections of the IMI were of the right length to allow me to complete them without needing a break.	3.80	0.91	25
Questions asked within the IMI were reasonable and helped me to understand the topic.	3.92	0.81	25
The questions asked within the IMI focused on what was being taught.	3.96	0.73	25
The overall focus of the IMI was right on target.	4.00	0.82	25
Total	3.92	0.63	25

Tracking progress. A single question was used to measure Soldiers' perceived ability to keep track of how well they would be able to suspend and resume training with the IMI. Due to the many demands competing for NCOs' attention, we felt this question should be asked in order to assess the viability of using the IMI in an on-the-job context. Soldiers were asked to rate the statement on a 5-point Likert style scale: "If I took a break during the learning process, I could

easily resume learning when I returned." Soldiers responded on a 5-point Likert style scale from 1 = Strongly Disagree to 5 = Strongly Agree. The average response to this item was $M = 4.00$, $SD = 0.76$ ($N = 25$).

Soldier Feedback on the Final Version of the IMI

Soldiers were asked to respond to an open-ended question asking them to identify potential improvements to the IMI. Suggestions covered a variety of topics focused on the design and content of the IMI. Some examples include:

- Increase interactivity: The material is great, but I had trouble staying focused. Make it more involved; not listening to people.
- Shorten the training: The information is good, but needs to be compressed.
- Control pacing: Do not make it so easy to click through.
- Improve graphics: Some 3D graphics instead of 2D would help.
- Focus on MOS: In the future maybe the IMI could be more MOS tailored if possible. All in all the IMI was very interactive.

Finally, some Soldiers commented on the visual presentation of Soldiers in ACU uniforms (the OCP uniform is becoming more common) and other details unique to the Army.

Soldier Assessment of Learning

Finally, Soldiers rated their confidence in being able to perform tasks addressed by the IMI before and after they completed the training. Soldiers responded to each item by rating the pre and post training confidence on a 10 point scale: 0 = Not certain I could/can do it; 5 = Moderately certain I could/can do it; 10 = Highly certain I could/can do it. A repeated-measures ANOVA was used to identify areas in which Soldiers perceived a significant difference in their confidence before and after training. Table 16 summarizes the results (see Appendix A for item-level results).

Table 16
Soldiers' Before and After Training Ratings of Confidence on Key Tasks

Item	Before		After				
	M	*SD*	*M*	*SD*	*F* (*df*)	*p*	η_p^2
Planning and Analyzing the Learning Situation	6.27	2.15	8.36	1.22	55.6 (1, 23)	<0.001	0.71
Seeking Sources of Information	6.62	1.97	8.46	1.27	53.0 (1, 23)	<0.001	0.70
Making Sense of New Information	6.43	2.38	8.43	1.31	38.0 (1, 23)	<0.001	0.62
Evaluating Individual Learning Outcomes	6.84	2.25	8.57	1.44	37.5 (1, 23)	<0.001	0.62
Attitudes and Motivations Supporting Learning	6.89	2.11	8.41	1.16	30.3 (1, 23)	<0.001	0.57

Note: $N = 24$ for reported analyses.

Soldiers indicated that they perceived improvement across the five factors measured. The degree of perceived improvement, attributed to the training, was roughly equivalent for each of the factors.

Discussion

This research was focused on testing two tailored-training designs utilizing an existing IMI package, and then developing and validating a final version of the IMI for transition to the Army. The topic of the training was self-directed learning skills for new Army NCOs (Specialists/Corporals, E-4, and Sergeants, E-5). Army NCOs are often expected to execute tasks on the job that they were not prepared for in the Schoolhouse (Graves, Rauchfuss, & Wisecarver, 2012). This IMI was intended as a training supplement to help new NCOs learn the skills that may be applied to support acquiring new knowledge and skills on the job. The IMI was also intended to be used as a mentorship tool that more senior NCOs can use to develop their subordinates (Blankenbeckler, Graves, Dlubac, & Wampler, 2016).

The research was accomplished in two phases. In the first phase, an existing IMI—"A Leg Up on Self-Learning: Strategies for Success" (see Blankenbeckler, Graves, Dlubac, & Wampler, 2016)—was modified into two variations. These variations included a designer-controlled instructional design, providing a structured sequence of topics within the training, and a learner-controlled instructional design, providing a diagnostic test and feedback to learners at the start of the training, which the learner could use to select a customized path through the training. These IMI instructional designs were compared in an experiment. In the second phase of the research, the two variations of IMI were combined into a single version, which was validated with NCOs enrolled in BLC at the Fort Sill, OK NCOA. The final version of the IMI was transitioned to the U.S. Army Sergeants Major Academy (USASMA; Fort Bliss, TX), who are the proponent for the BLC course throughout the Army.

Learner-Controlled versus Designer-Controlled IMI Designs

Two variations of the IMI were tested with NCOs enrolled in the BLC and ALC courses at Fort Benning, GA, and Fort Eustis, VA. The findings indicated that both instructional design variations were successful in training Soldiers on self-directed learning skills; however, there was no statistically significant differences found between IMI variations in terms of learning outcomes. With respect to Soldiers' learning experiences, ratings of quality of design and content, continuity of topics, credibility of examples, and focus and relevance of the content, no statistically significant differences were found. A significant difference was found concerning how Soldiers perceived their ability to track their progress through the IMI, with a medium size effect favoring the designer-controlled instructional design over the learner-controlled instructional design.

In previous research, we found that Soldiers who were less familiar with a topic domain tended to benefit from an instructional design that focused on their individual learning needs (Graves, Blankenbeckler, Wampler, & Roberts, 2016). In this case, we did not find a similar result. Assuming that level of education would be associated with Soldiers' familiarity with self-directed learning techniques, we found that NCOs who had completed college fared no better in

test performance than did NCOs with associates degrees and below, regardless of IMI type. Rank, likewise, did not interact with IMI type, although NCOs who were higher ranked tended to exhibit the greatest increase in test scores between the pretest and posttest. A possible explanation for this contradictory evidence could be due to the content domain being examined. In our earlier research, the topic domains on which they training focused were specific Army tasks: Conducting a Defense by a Squad and Adjusting Indirect Fire. Both these tasks consist of a constrained set of steps and are procedural in nature. In that earlier research, we were manipulating familiarity with a task. The assumption in the current research was that Soldiers would have familiarity with some self-directed learning strategies and techniques, and less familiarity with others. Self-directed learning skills tend to be more generally applicable and likewise more open-ended in how they are conceptualized and learned. Individual learning preferences likely play a role in what strategies and techniques a Soldier has honed (Graves, Rauchfuss, & Wisecarver, 2012). Many of the skills covered in the NCO self-directed learning skills training were metacognitive, although we did seek to make them concrete by providing Army specific examples and self-assessment activities to engage Soldiers who may not have immediately recognized the applicability of the training content.

Given the conceptual—rather than procedural—nature of the topic domain, the potential differences between training with a designer-controlled instructional design and a learner-controlled instructional design may have been made negligible. Knowledge of 'Conducting a Defense by a Squad' and 'Adjusting Indirect Fire' is procedural and task dependent knowledge, meaning that it concerns knowledge of factual information as it applies to a specific performance domain (see De Jong & Ferguson-Hessler, 1996). Conditional knowledge of strategies and techniques for learning tend to emphasize when, where, and how particular strategies and techniques are applicable. In this case, the training was focused on how to structure a learning process and therefore may not have benefitted from instructional training designs we initially developed concerning procedural and task-dependent topic domains. Additional research to identify instructional design features specifically benefitting training in abstract, conditional knowledge may be warranted.

Validation of the Final Version of the IMI

Given that neither of the instructional design formats indicated a difference in performance or in overall learning experience, we combined features of both design formats in developing the final version of the IMI. To do this, we relied on Soldiers' written recommendations as well as standard techniques, such as checks on learning, in the redesign. Again, the training was effective, with Soldiers showing statistically significant improvement in test performance between the pretest and posttest, with a slightly stronger effect overall (η_p^2 = 0.26 when comparing the two variations of the IMI; η_p^2 = 0.34 for the validation version). This strengthened effect may be due to the smaller and more homogenous sample in the validation phase of the research: we specifically targeted BLC students. Soldiers' ratings of the quality of their learning experience were roughly comparable to those of the earlier phase of the research, although means for the final validation version of the IMI were slightly higher than the learner-controlled and designer-controlled variations. See Table 17 for a summary of the means for comparison.

Table 17
Summary of Means on the Learning Experience Questionnaire for the Validation IMI Compared to the Earlier Design Variations

Factor	Validation IMI	Learner-Controlled IMI	Designer-Controlled IMI
Quality of the Learning Experience	3.61	3.26	3.14
Quality of Design and Content	4.05	3.97	3.97
Continuity of Topics	4.02	3.87	3.96
Credibility of Examples	3.87	3.55	3.67
Focus and Relevance	3.92	3.73	3.68
Tracking Progress	4.00	3.65	4.11

Soldiers rated their quality of learning experience, quality of design and content, continuity of topics, credibility of examples, and focus and relevance higher for the validation IMI than they did for the learner-controlled and designer-controlled variations. Ability to track progress in the IMI was rated highest for the designer-controlled variation.

Measures of confidence in performing tasks. An optimal validation strategy for this research would have been longitudinal, following up with trained Soldiers on the job to see if they had in fact applied what they learned from the IMI. Due to the lack of mechanisms for tracking Soldiers from BLC to their first assignment as NCOs, we utilized an alternative procedure. We asked Soldiers to rate their confidence in performing the tasks trained before and after the training. Soldiers reported a statistically significant increase in their confidence in their ability to perform tasks within the five areas addressed by the training: (a) planning and analyzing the learning situation, (b) seeking sources of information, (c) making sense of new information, (d) evaluating individual learning outcomes, and (e) attitudes and motivations supporting learning. The greatest increase in confidence was associated with planning and analyzing the learning situation ($\Delta_{M\ after\ -\ M\ before} = 2.09$), followed by making sense of new information ($\Delta_{M\ after\ -\ M\ before} = 2.00$), seeking sources of information ($\Delta_{M\ after\ -\ M\ before} = 1.84$), evaluating individual learning outcomes ($\Delta_{M\ after\ -\ M\ before} = 1.73$), and attitudes and motivations supporting learning ($\Delta_{M\ after\ -\ M\ before} = 1.52$). All 31 of the skills and strategies evaluated within the five areas were associated with a significant increase in Soldiers' confidence.

Design versus Content

The results indicated that the quality of the content may have had a far more significant impact on the performance and motivational/confidence outcomes of the validation than did the different tailored training design features we sought to incorporate into the training. The basic lesson may be that for many topic domains, the tailorability of training may not be as important as the quality of the content provided. As long as specific design features do not distract a learner from the core focus of the domain being trained, a number of different types of instructional design features may be effective in training Soldiers. As long as the basic exposition and development of content areas is logical, Soldiers may benefit from the training. Moreover, the individualized feedback a learner receives from a tailored training approach may serve to motivate them in the learning process.

Various expository and design features of IMI have been proposed to facilitate learners in engaging with and learning new information (Blankenbeckler, Graves, & Wampler, 2014; Graves, Blankenbecker, Wampler, & Roberts, 2016; Ingurgio, Blankenbeckler, & Wampler, in press). Critical to the design process is incorporating features that (a) reduce the amount of thinking learners have to do about off-topic concerns, (b) help learners to manage their thinking processes while learning, and (c) encouraging learners to understand new information from their own perspective (see Veronikas & Shaughnessy, 2005; Mayer, 2009; Moreno & Mayer, 2007; Clark & Mayer, 2008). Table 18 summarizes these central design features.

Table 18
Central Instructional Design Features for IMI

Goal	**Feature**	**Description**
Reduce Off-Topic Thinking (e.g., Distractions)	Coherence	Eliminating extraneous words, pictures, images
	Signaling	Highlighting important words (e.g., section headings, highlighting, boldface font)
	Redundancy	Combining animations with narrations rather than animation, narration and text
	Spatial Contiguity	Placing corresponding portions of pictures and words near each other
	Temporal Contiguity	Presenting corresponding animation and narration simultaneously rather than successively
Help Learners Managing Their Thinking Processes	Segmenting	Presenting narrated animation in learner-paced segments
	Pretraining	Providing pre-training in vocabulary and key concepts (e.g., outlines, key learning objectives, bottom line up front)
	Modality	Combining animation (visual) with narration (auditory), not animation (visual) with text (visual)
	Guided Activity	Prompting learners to select, organize, and integrate new information
	Reflection	Encouraging self-reflection to activate organization and integration of new information
	Feedback	Providing learners with proper schemas to repair misconceptions
	Worked Examples	Leveraging worked examples to show how to work though tasks/problems step-by-step
Encourage Learners to Incorporate New Information into their Own Perspective	Personalization	Communicating in an informal/conversational style
	Voice	Narrating in a non-accented voice rather than a machine-simulated voice
	Pacing	Allowing learners to control their pace, and process smaller chunks of information in working memory
	Sequencing	Ordering information to move from old (familiar) information to new (unfamiliar) information
	Clear Structure	Using a familiar structure/pattern for presenting information (e.g., compare-contrast, classification, enumeration, cause-effect)

Note: Table was adapted from Blankenbeckler, Graves, & Wampler (2014), and Ingurgio, Blankenbeckler, & Wampler (in press).

The design features outlined in Table 18 were incorporated into all versions of the IMI and served as solid principles for the structuring and presentation of content. The additional tailored training design features may have served to support the engagement of Soldiers in the learning process, although ultimately they did not make a difference in terms learning performance outcomes on the pretest and posttest, nor did they make a significant different in terms of the Soldiers' ratings of their quality of learning experience.

Recommendations for Using the IMI

The current version of the IMI is viable for applications in professional development training for new NCOs, and as a tool for more senior Leaders to use in mentoring new NCOs. Overall, the training was positively received by NCOs in the BLC courses in which we conducted the training assessment. In particular, NCOs felt that the course content provided them with a better understanding of the professional development requirements of being an NCO in today's Army, and supported them in locating resources to address their career goals in greater depth.

Many of the skills addressed in the training are also introduced and developed during the experience of civilian undergraduate education. Most early career NCOs have completed their secondary education and are working toward a college degree. The self-directed learning strategies and techniques they will learn from the IMI as well as the Army NCO specific career resources it consolidates may be beneficial to them in setting a successful career trajectory. For NCOs more senior in their careers, the IMI provides a structured way to learn to recognize and develop these strategies and techniques in new NCOs who may be in the process of working toward completing their post-secondary education.

Limitations

An inevitable limitation of much of applied research is small sample size. The sample sizes in this research, while viable, were necessarily limited by the availability of Soldiers. BLC and ALC courses tend to be small, consisting of high-performing Soldiers and NCOs who have been selected for promotion into and within the NCO Corps. Small sample size limited the types and complexity of statistical analysis we used to identify differences between the variations of IMI as well as our validation of the final version of the IMI. Moreover, the ideal way to conduct a validation would be to follow-up with trained Soldiers later to see if they have effectively applied what they learned from the course. In this respect, our validation was limited to Soldiers' pretest-training-posttest performance, general impressions of the quality of the training, and their ratings of confidence in performing the trained tasks—all data collected in a single 2.5 hour session. If this training were presented to NCOs on the job, they would likely have more time available to work through the various sections of the course, and would work through each section at a slower pace, as their time permits. A slower pace would allow for greater depth of learning from the IMI materials.

Additional research may explore in greater depth the potential of tailored training instructional designs that focus on different types of knowledge and skill development. This research could address the question of whether tailored training strategies that support the

development of procedural knowledge and its applications may be less effective when applied to train more generally applicable conceptual knowledge, such as the self-directed learning strategies and techniques trained in this research.

References

Bankus, T. A. (2016). *Self-regulation and cognitive load as mediating factors for tailored interactive multimedia instruction* (Doctoral dissertation). Retrieved from Old Dominion University Digital Commons. (ISBN 9781369538380)

Blankenbeckler, P. N., Graves, T. R., & Wampler, R. L. (2013). *Addressing point of need in interactive multimedia instruction: A conceptual review and evaluation*. (ARI Research Report 1969). Fort Belvoir, VA: U.S. Army Research Institute for Behavioral and Social Sciences.

Blankenbeckler, P. N., Graves, T. R., & Wampler, R. L. (2014). *Designing interactive multimedia instruction (IMI) to address Soldiers' learning needs.* (ARI Research Report 1979). Fort Belvoir, VA: U.S. Army Research Institute for Behavioral and Social Sciences.

Blankenbeckler, P.N., Graves, T.R., Dlubac, M., & Wampler, R.L. (2016). *Interactive Multimedia Instruction for Self-Directed Learning Techniques*. ARI Research Product 2016-05). Fort Belvoir, VA: U.S. Army Research Institute for the Behavioral and Social Sciences.

Clark, R. C., & Mayer, R. E. (2008). *E-Learning and the science of instruction: proven guidelines for consumers and designers of multimedia* (2nd Ed.). San Francisco: Wiley-Pfeiffer.

Department of the Army (2011). *The United States Army Learning Concept for 2015*. (TRADOC Pam 525-8-2). Fort Monroe, VA: Department of the Army, Training and Doctrine Command.

Department of the Army (2017). *The U.S. Army Learning Concept for Training and Education, 2020-2040* (TRADOC PAM 525-8-2). Fort Monroe, VA: Department of the Army, Training and Doctrine Command.

De Jong, T., & Ferguson-Hessler, M. G. M. (1996). Types and qualities of knowledge. *Educational Psychologist, 31*(2), 105-113.

Graves, R., Blankenbeckler, N, & Wampler, R. (2014). *Tailoring multimedia instruction to Soldier needs.* Paper published in the proceedings of the Interservice/Industry Training, Simulation, and Education Conference (I/ITSEC), 1 – 4 December 2014, Orlando, FL.

Graves, T. R., Blankenbeckler, P. N., Wampler, R. L., & Roberts, A. (2016). *A Comparison of Interactive Multimedia Instruction Designs Addressing Soldiers' Learning Needs* (ARI Research Report 1996). Fort Belvoir, VA: U.S. Army Research Institute for the Behavioral and Social Sciences.

Graves, T. R., Rauchfuss, G., & Wisecarver, M. (2012). Self-learning among Army Noncommissioned Officers: Experiences, attitudes, and preferred strategies (ARI Research Report 1961). Fort Belvoir, VA: U.S. Army Research Institute for the Behavioral and Social Sciences.

Ingurgio, V. J., Blankenbeckler, P. N., & Wampler, R. L. (in press). *Computer-based Training Development and Guidance for the Army*. (ARI Research Product TBD). Fort Belvoir, VA: U.S. Army Research Institute for Behavioral and Social Sciences.

Karrer, T. (2010). Text-to-Speech vs. Human Narration for eLearning. Retrieved from: http://elearningtech.blogspot.com/2010/09/text-to-speech-vs-human-narration-for.html

Knowles, M. S. (1975). *Self-directed learning.* New York: Association Press.

Mayer, R. E. (2008). Applying the Science of Learning: Evidence-Based Principles for the Design of Multimedia Instruction. *American Psychologist*, 760-769.

Mayer, R. E. (2009). *Multimedia learning* (2nd Ed.). New York: Cambridge University Press.

Mayer, R. E. (2014). *Research-based principles for designing multimedia instruction*. Retrieved from: http://hilt.harvard.edu/files/hilt/files/background_reading.pdf.

Moreno, R., & Mayer, R. (2007). Interactive multimodal learning environments. *Educational Psychology Review, 19*, 309-326.

Veronikas, S., & Shaughnessy, M. F. (2005). An interview with Richard Mayer. *Educational Psychology Review, 17*, 179-189.

Wisecarver, M., Foldes, H., Ferro, G., Cullen, M., Graves, T. R., Rauchfuss, G., Wolfson, N., & Kraiger, K. (2012). *Defining the antecedents for Noncommissioned Officer self-learning: A review of the literature* (ARI Technical Report 1300). Arlington, VA: U.S. Army Research Institute.

List of Acronyms

AKO	Army Knowledge Online
ALC	Advanced Leadership Course
ANOVA	Analysis of Variance
ARI	Army Research Institute for the Behavioral and Social Sciences
BLC	Basic Leadership Course
BN	Battalion
CSM	Command Sergeant Major
IMI	Interactive Multimedia Instruction
INCOPD	Institute for Noncommissioned Officer Professional Development
M	Mean
MOS	Military Occupational Specialty
N	Sample Size
NCOA	Noncommissioned Officer Academy
NCOs	Noncommissioned Officer
SD	Standard Deviation
SGT	Sergeant
SPC/CPL	Specialist/Corporal
SSG	Staff Sergeant
SSD	Structured Self-Development

APPENDIX A

SOLDIERS' BEFORE AND AFTER TRAINING RATINGS OF CONFIDENCE ON KEY TASKS

Table A-1

Soldiers' Before and After Training Ratings of Confidence on Key Tasks

	Item	Before		After				
		M	*SD*	*M*	*SD*	*F* (*df*)	*p*	η_p^2
Planning and Analyzing the Learning Situation		**6.27**	**2.15**	**8.36**	**1.22**	**55.6 (1, 23)**	**<0.001**	**0.71**
1.	Clearly defining what I need to learn when beginning the learning process.	6.00	2.43	8.75	1.29	50.6 (1, 23)	< 0.001	0.68
2.	Identifying what I hope to be able to do as a result of what I am learning.	6.58	2.52	8.46	1.47	39.9 (1, 23)	< 0.001	0.63
3.	Breaking down my overall learning task into smaller, manageable parts.	6.25	2.66	8.37	1.64	31.7 (1, 23)	< 0.001	0.58
4.	Planning step-by-step what I need to do in working toward my learning goal.	6.79	2.48	8.63	1.28	31.3 (1, 23)	<0.001	0.58
5.	Pacing my learning to minimize conflict with my other obligations.	5.92	2.53	8.29	1.46	41.1 (1, 23)	<0.001	0.64
6.	Prioritizing learning tasks and/or topics that need to be covered.	6.56	2.50	8.26	1.57	27.5 (1, 22)	<0.001	0.56
7.	Developing a timeline, roadmap, or list of milestones and use them to track my progress.	5.50	2.78	7.83	1.76	34.4 (1, 23)	<0.001	0.60
8.	Setting a deadline to complete my learning task and/or produce a product.	6.54	2.70	8.25	1.45	15.6 (1, 23)	0.001	0.41
Seeking Sources of Information		**6.62**	**1.97**	**8.46**	**1.27**	**53.0 (1, 23)**	**<0.001**	**0.70**
9.	Identifying my most likely sources of good information (e.g., libraries, CALL).	6.42	2.47	8.33	1.49	33.9 (1, 23)	<0.001	0.60
10.	Collecting examples of completed work (e.g., briefings) to use as a model.	6.22	2.35	8.48	1.44	31.4 (1, 22)	<0.001	0.59
11.	Thinking about experiences I have had (or examples I know about) to help me make sense of what I am learning.	7.04	2.44	8.75	1.51	31.6 (1, 23)	<0.001	0.58
12.	Seeking opportunities to learn things hands-on; getting someone to show me.	7.35	2.33	9.09	1.04	23.7 (1, 22)	<0.001	0.52
13.	Supporting my learning with computer programs, CDs, videos (e.g., language learning software).	6.58	2.36	7.96	2.22	22.7 (1, 23)	<0.001	0.48
14.	Keeping a list, spreadsheet, notebook, etc., to track the resources I have collected and read.	6.04	2.40	8.13	1.65	41.4 (1, 23)	<0.001	0.64
Making Sense of New Information		**6.43**	**2.38**	**8.43**	**1.31**	**38.0 (1, 23)**	**<0.001**	**0.62**
15.	Summarizing what I am learning in my own words.	6.65	2.71	8.70	1.55	31.6 (1, 23)	<0.001	0.59
16.	Spending extra time focusing on information that seems new, unusual, or confusing.	6.50	2.93	8.46	1.56	20.6 (1, 23)	<0.001	0.47
17.	Diagramming/white-boarding concepts and processes to understand them better.	6.46	2.48	8.13	1.70	27.7 (1, 23)	<0.001	0.55
18.	Seeking out different alternatives and points-of-view to help challenge/verify what I am learning.	6.42	2.53	8.50	1.47	27.9 (1, 23)	<0.001	0.55
19.	Using mental imagery for 'what if' scenarios and/or to rehearse procedures.	6.29	2.82	8.38	1.56	19.0 (1, 23)	<0.001	0.45

Table A-1
Soldiers' Before and After Training Ratings of Confidence on Key Tasks (continued)

	Item	Before		After				
		M	*SD*	*M*	*SD*	*F* (*df*)	*p*	η_p^2
Evaluating Individual Learning Outcomes		**6.84**	**2.25**	**8.57**	**1.44**	**37.5 (1, 23)**	**<0.001**	**0.62**
20.	Asking trained Cadre and/or SMEs for advice and feedback on my performance.	6.70	2.82	8.58	1.90	19.7 (1, 23)	<0.001	0.46
21.	Seeking opportunities to teach/explain to others what I have learned.	6.83	2.14	8.54	1.44	34.3 (1, 23)	<0.001	0.60
22.	Assessing my progress in terms of 'crawl, walk, run'.	7.13	3.13	8.75	1.87	16.3 (1, 23)	0.001	0.41
23.	Evaluating how well I was able to achieve my learning goals.	6.70	2.46	8.42	1.56	29.3 (1, 23)	<0.001	0.56

Table 16

Soldiers' Before and After Training Ratings of Confidence on Key Tasks (Continued)

Item	Before		After				
	M	*SD*	*M*	*SD*	*F* (*df*)	*p*	η_p^2
Attitudes and Motivations Supporting Learning	**6.89**	**2.11**	**8.41**	**1.16**	**30.3 (1, 23)**	**<0.001**	**0.57**
24. Identifying new experiences, challenges, and/or assignments.	6.79	2.19	8.63	1.21	26.0 (1, 23)	<0.001	0.53
25. Identifying new problems to solve.	6.45	2.55	7.79	1.86	11.2 (1, 23)	0.003	0.33
26. Continuing to work at learning something, even when it is difficult.	7.54	2.72	8.79	1.38	13.4 (1, 23)	0.001	0.37
27. Using failures as an opportunity to learn.	7.37	2.67	8.88	1.65	21.4 (1, 23)	<0.001	0.48
28. Keeping up with learning in order to stay knowledgeable.	6.83	2.58	8.50	1.47	18.4 (1, 23)	<0.001	0.44
29. Learning what I need to in order to be effective in my job.	7.50	2.55	8.71	1.55	17.5 (1, 23)	<0.001	0.43
30. Exploring new or better ways to learn.	6.58	2.57	7.92	1.79	19.1 (1, 23)	<0.001	0.45
31. Monitoring what I am doing when I am learning.	6.04	2.37	8.04	2.16	26.3 (1, 23)	<0.001	0.53