INTELLIGENT TUTORING IN THE WILD: LEVERAGING MOBILE APP TECHNOLOGY TO GUIDE LIVE TRAINING

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ABSTRACT

Mobile computing technologies are extending how people can interact with educational and training content in a whole new way. Through high resolution displays, intuitive user interfacing, embedded sensing technologies, and well supported app development communities, there is a plethora of content that can be used to build effective materials that target knowledge and skill development. To truly enhance this new training paradigm, extending Intelligent Tutoring System (ITS) to support mobile interactions can provide a new means to managing training in a rich contextualized environment. In this instance, learning takes place in the natural environment where directed experiences focus on the elements surrounding one's location. In this paper, we describe the development of a new mobile ITS application using the Generalized Intelligent Framework for Tutoring (GIFT; Sottilare, Goldberg, Brawner & Holden, 2012). The domain of land navigation was applied as a use case, with direct support for the United States Military Academy at West Point. We describe the training concept, how GIFT was extended to support this concept from an architectural and assessment standpoint, along with implementation plans for an initial training effectiveness study.

Keywords: workstation design, work measurement, ergonomics, decision support system

1. INTRODUCTION

Intelligent Tutoring Systems (ITS) are computer-based applications that apply artificial intelligence modeling techniques to provide individualized learning experiences. They are traditionally developed for desktop and laptop computing environments, with empirical evaluations showing effect sizes up to 1 standard deviation in well-defined academic domains (e.g., physics, algebra, computer programming, etc.) when compared against traditional instructional methods (VanLehn, 2011). With investments across the Department of Defense to leverage ITS methods to enhance Simulation-Based Training (SBT) methods, it is recognized that new interaction modalities are required to compensate for the interaction space across military training contexts.

As interfacing technologies continue to mature in mobile contexts, smartphone technology is prime for extending ITS benefits into less traditional delivery formats. This new paradigm also provides a new context by which a learner can interact with physical environments beyond the traditional classroom.

In this paper, we present work associated with the development of an ITS mobile application (app) that trains land navigation skill sets. The app is designed around the GIFT specification (Sottilare, Goldberg, Brawner & Holden, 2012), and was implemented in a generalizable fashion that can extend across many domains. We begin by describing the vision behind this work from a learning science perspective, followed by modifications to the GIFT architecture to support the implementation. We then conclude with an overview of how the app was applied for a land navigation use case, along with the study design used to gauge its impact.

2. THEORY BEHIND SIMULATION AND TRAINING

The benefit associated with SBT platforms is they provide realistic environments that allow individuals to master complex material and learn and apply new information through execution of simulated tasks (Menaker, Coleman, Collins, & Murawski, 2006). The learning process is influenced by student-centered teaching methods prompted by theories of 'discovery' (Bruner, 1966; Hermann, 1969) and 'active' (Johnson, Johnson, & Smith, 1991) learning. They incorporate interacting elements of logic, memory, visualization, and problem solving that cater to elements required for learning; engagement, interaction, and satisfaction (Amory, Naicker, Vincent, & Adams, 1999). This is achieved by replacing traditional classroom instructional techniques with methods of role-playing, simulations, self-regulated exercises, and other types of problems requiring creative and critical thinking skills (Greitzer, Kuchar, & Huston, 2007). Research has demonstrated these forms of training to be an effective alternative to traditional classroom instruction because they assist learners in rapidly creating and adjusting mental models for newly acquired information (Cuevas, Fiore, Bowers, & Salas, 2004). These environments also provide a forum for learners to actively participate with learning material and to view the effect varying actions have on outcomes.

2.1. Learning by Doing

The application of SBT across military domains allows for the development of authentic scenarios that facilitate learning and cognitive development. In the military context, interactions in a simulated exercise enable visualization and practice of task execution. As a result, learners come to their first live performance experience with an advantage (Waldman, 2009). In addition, SBT enables Soldiers to interact with multiple scenarios in a short timeframe. This allows for rapid exposure to variations in task conditions that build task relevant experience (Pine, 2009). In these instances, executing live simulated exercises is ideal; however, they are traditionally confined to indoor environments that use virtual interfacing to create the stimuli to interact within.

While technology-enabled SBT has seen success in virtual and constructive application environments, applying SBT technologies to facilitate self-regulated live training exercises has not received extensive attention. Yet, with advancements in adaptive instructional systems, and the maturity level of the Generalized Intelligent Framework for Tutoring (GIFT), adaptive training pedagogical practices can now be embedded in smartphone apps using cloud-based infrastructures.

A primary goal of many modern military training systems is to provide the learner with strategies that aid in the development of higher-order thinking skills and enable them to adapt decision-making tactics under variable missions and conditions (Wisher, Macpherson, Abramson, Thorton, & Dees, 2001). In today’s combat environment, tasks are executed under a multitude of complex, stressful, and ambiguous settings where decisions must be quick and actions must be executed in a timely manner (Salas, Priest, Wilson, & Burke, 2006). Therefore, training aims to foster successful task execution and the values associated with making reasonable decisions under difficult circumstances (Bratt, 2009). SBT fosters this type of learning by applying principles of instructional design through the processes of development, application, and evaluation of task relevant KSAs in realistic situations (Oser, Cannon-Bowers, Salas, & Dwyer, 1999).

SBT simply replicates a real-world representation of a problem space where knowledge, skills, and abilities can be applied within bounded realistic conditions that aid in skills training (e.g. time pressure, stress). However, simulating a task in a physical environment and providing the ability for an individual to practice does not on its own increase expertise (Ericsson & Ward, 2007). Expertise development in SBT platforms is not practical without apt pedagogical support (Ericsson & Ward, 2007). This is a recognized gap because too often simulations are fielded without pedagogical components and functions. Simulations intended for education and training provide a means for practicing KSAs, but as mentioned above often lack elements of pedagogy that guide the learning process (Nicholson, Fidopiastis, Davis, Schmorrow, & Stanney, 2007). This limitation is the forcing function for advancements in ITS applications within military domain spaces. To meet this evolving need, ITS applications are required for task spaces that involve a combination of cognitive and psychomotor components, where tasks are executed in dynamic environments. To meet this training need, extending ITS functions to mobile platforms is critical.

2.2. A Use Case: Land Navigation

Land navigation is an excellent use case to inform initial development efforts of a mobile adaptive instructional system. This is due to the nature of domain’s knowledge components and how current training programs are executed. The initial objective is to replicate exercises and scenarios that are currently instructor led and utilize elements of the natural environment. As a grounding function, we partnered with the United States Military Academy’s (USMA) Department of Military Instruction (DMI) to determine design requirements. DMI is responsible for establishing training programs administered to new cadets that focus on foundational skills required for functioning within the Army. For land navigation, a five-day program is administered that incorporates classroom instruction, virtual SBT in a game-based environment, live instructor-led training outdoors, and live practice opportunities all before a culminating qualification event.

A specific event administered on day two of training is what is called a Terrain Walk. The established method of a Terrain Walk incorporates one instructor to a group of learners; in this case a squad of new cadets. The new cadets are guided up a mapped out path with training interventions initiated at specific points along the trail. At each point, a new training objective is targeted, where the instructor engages the group through conversational cueing. The goal of the exercise is to reinforce material covered in classroom instruction through contextualized active learning.

One utility an ITS in this domain aims to provide is self-regulated interactive scenarios that promotes skill acquisition for each individual trainee. This involves providing scaffolds for learners who do not possess the skills to conduct the tasks, and challenging those with prior experience. While the current collective nature of the training allows for direct learner interaction with subject matter experts with years of experience, it reduces hands-on opportunities for all members of a squad, and potentially results in disengaged learners. To address this, the app is being designed to replicate tasks performed in the traditional form, but providing a mechanism that allows each individual learner to perform each scenario at their own pace. In the following sections we review the developmental efforts applied to create the first iteration of a Terrain Walk oriented mobile ITS app.

3. BUILDING A LAND NAVIGATION APP

3.1. Generalized Intelligent Framework for Tutoring (GIFT)

GIFT is a modular framework of software tools designed to simplify authoring ITS applications by providing a configurable tutoring engine that can be integrated with other software (see Figure 1). GIFT has been used in the past to perform assessments based on learners' movements in simulated 3D environments and provide instructional feedback based on their actions within said environments. This same principle of tracking learners' movements in simulated environments can be applied to interactions with mobile devices in live environments. Instead of monitoring learners' positions in a simulated setting, GIFT can take advantage of mobile devices' built-in Global Positioning System (GPS) services to track learners' real-world locations and perform the same assessment operations that it would in a simulated environment. This is the goal that was used to guide the changes made to the GIFT architecture and the development of the mobile ITS application.

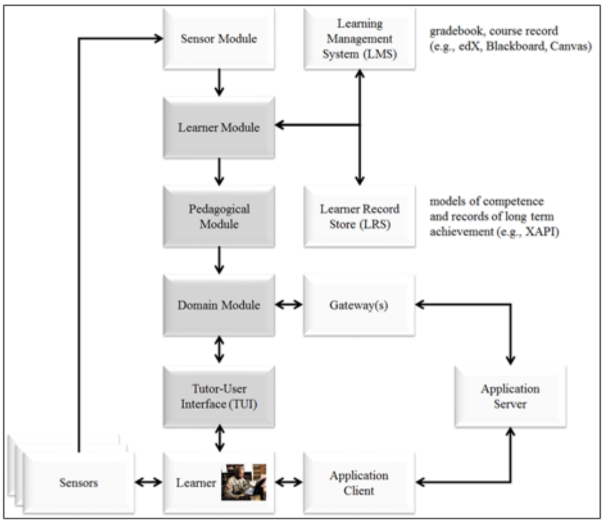


Figure 1: The GIFT Framework Represented by its Modular Components and Their Message Flow Dependencies

3.2. Architecture Modifications

While GIFT has been used before to track the locations of learner entities in simulated environments, the geolocation data passed from mobile devices uses a geodetic (GDC) coordinate system that GIFT's assessment logic was not originally designed to handle. To accommodate this new coordinate system, GIFT's internal messaging logic had to be modified to properly encode and decode the coordinates received from mobile devices' GPS services.

Mobile devices also provide features to display notifications and vibrate that GIFT can take advantage of to provide additional hands-free feedback to learners; features that are particularly useful for conducting live training since learners may not always be looking at the mobile device's screen. To access these features, GIFT's internal messaging system was further modified in order to add new command messages that tell the mobile device to display notifications and vibrate the phone. These new messages were then incorporated into the existing logic that GIFT uses to display messages in other software applications, since this same messaging pipeline would eventually be used to build the gateway needed to communicate with the phone's operating system and gather GPS data from cellular networks

Additional changes were also made to GIFT's authoring tools and domain module. A new type of course object was added to GIFT's course creator to allow authors to use the new mobile ITS app as an inherent training environment interacting with GIFT. Unlike most training applications, GIFT itself was not planned to run alongside the app on a mobile device's operating system, since GIFT cannot currently be installed on mobile devices.

Instead, an instance of GIFT was launched on a publicly-facing server so that the mobile ITS app could display that GIFT tutoring interface as an embedded web page. This approach allows learners to take courses with GIFT and interact with the mobile ITS app at the same time, without installing any GIFT software to their mobile device itself. The approach also posed a challenge for the logic GIFT normally uses to communicate with training applications, since a training application would typically use an instance of GIFT's gateway module running on the same operating system to communicate with the rest of GIFT's modules. Fortunately, work from a previous effort had set up a communication mechanism in GIFT's tutoring interface to allow web-based Unity applications to communicate with GIFT without using the gateway module, effectively using GIFT's tutor module as a surrogate. This communication mechanism was modified to allow GIFT and the mobile ITS app to send messages to one another, which, in turn, allowed the creation of the gateway needed for GIFT to receive GPS data from a cellular network through a mobile device.

3.2.1. Building a Gateway to a Cellular Network

Since a publicly-facing hosted GIFT instance was set up to allow the mobile ITS app to embed GIFT's tutoring interface, the ITS app had to be set up to both provide a way to view the GIFT webpage and to handle communications with GIFT to perform operations using the mobile device. MIT's Ionic framework was chosen to facilitate this setup process, since it provides a built-in interface that can use embedded web pages to create mobile apps and expose native mobile device features to said web pages (www.ionicframework.com, 2018). By using Ionic, the mobile ITS app's user interface was set up to allow new cadets to pick from several pre-defined courses on the hosted GIFT instance and begin running them at the tap of a button, all within a single mobile app.

With GIFT's tutoring interface now embedded within the mobile ITS app via Ionic, the only remaining hurdle for establishing a gateway to the cellular network was to define the messages that GIFT and the mobile ITS app would send one another and define what operations would be invoked when those messages were received. Since a similar messaging process had already been established for web-based Unity applications, the bulk of the encoding and decoding process used for sending and receiving messages between GIFT and Unity was reused for the mobile ITS app. The existing message types that were used to load and pause Unity applications were re-used to allow GIFT to declare when it wanted to start and pause GPS location tracking, and a message type that was used to display messages in Unity applications was reused to display textual notifications on mobile devices and vibrate them via Ionic. A new "Geolocation" message type was also introduced to allow GIFT to receive updates of the mobile device's GPS location that are requested every second by Ionic. Now that the necessary messaging system and native device calls had been set up between GIFT and the mobile ITS app, the last remaining step to building the land navigation app was to set up assessment logic to allow GIFT to process the GPS location data received from mobile devices.

3.3. Handling Assessment and Pedagogy

Since GIFT's messaging logic had already been modified to handle the GDC location coordinates received from mobile devices' GPS services, the bulk of the changes that needed to be made to GIFT's assessment logic involved simply adjusting condition classes to correctly calculate distances and locations using GDC coordinates. In order to allow the land navigation app to use GPS location data to detect when learners reached certain locations and followed certain paths, GIFT's AvoidLocationCondition, EnterAreaCondition, and CooridorBoundaryCondition classes were all modified to be able to process GDC coordinates just as they would with coordinates from simulated environments. A new PaceCountCondition class was also created to allow GIFT to track learners as they walked a predefined distance and provide feedback once they reported that they had walked that distance.

As for GIFT's pedagogical logic, a need arose for GIFT to be able to display media such as YouTube videos and slide shows as a form of remediation if a learner answered a question improperly while walking through the live scenario. To fulfill this need, a new type of pedagogical strategy was added to GIFT to allow it to display such media during a training scenario, and GIFT's authoring tools were also updated to allow course authors to use this new strategy type. Together, the changes made to GIFT's assessment and pedagogical logic helped build out the course content that was used by the land navigation app as part of its integration into the land nav curriculum.

4. INTEGRATION IN LAND NAV CURRICULUM

With the underlying architectural components in place to support intelligent tutoring in a mobile context, the next task was applying existing module components to an explicit domain use case. With backing from DMI at USMA, the GIFT mobile app was applied to support a Terrain Walk exercise administered to new cadets. In this section, we will give a breakdown of the authoring workflows required to support a Terrain Walk mobile exercise using GIFT, along with examples of those workflows applied for specific training tasks, and a study design applied to gauge the impact of this new type of training intervention and its return on investment.

4.1. Building a Land Navigation Intelligent Mobile App

When designing the learner experience for a mobile Terrain Walk, the following storyboard was generated in collaboration with DMI (see Figure 2). The training event is setup to guide a learner up a path, with activities executed at designated points along the way; as marked by the black dots on the map below. Each activity is designed so that it requires on the spot problem solving through interaction with an individual's available tools (i.e., map, compass, protractor, notebook, etc.) and the natural environment around you. The key objectives instructed include (1) map orientation, (2) terrain association, (3) pace count confirmations, (4) compass checks, and (5) dead-reckoning for building route narratives.

Figure 2: Terrain Walk Exercise Map with Route and Designated Activity Waypoints

When implementing the defined storyboard, there were a number of items to design and instantiate. Primarily, we were concerned with what triggers were required to inform GIFT that an activity should be delivered, and how that activity would be administered so as to collect relevant performance information that can be used to infer competency and guide coaching. The first step is establishing a DKF that outlines the tasks a learner will be asked to perform, the concepts those tasks are designed to target, conditions and standards by which those concepts are assessed, and feedback/remediation material used to coach a learner when errors in performance are recognized. This cognitive task analysis activity establishes a high-level breakdown that designates what needs to be configured within the GIFT authoring tools.

Following this task breakdown, the next activity is configuring the DKF in GIFT's authoring environment. This requires the following: (1) establishing a set of tasks (e.g., plan route from Waypoint A to Waypoint B), (2) configuring start-/end-triggers for each task that activates assessments based on task context, (3) building instructional activity prompts that are displayed when a start-trigger is satisfied, (4) defining the concepts that are assessed within each activity, (5) configuring logic to inform assessments based on the context of the activity, and (6) establishing feedback and remediation when assessments show poor performance and misconceptions. This resulting DKF is used at training runtime to manage the entire learner experience for a given scenario event, with the intent to provide guidance when needed, and to increase challenge when warranted.

One challenge we recognized was the potential for the GIFT mobile app to freeze or crash at a given instance. In this situation, the way in which tasks and DKFs are established is very important. At the first go, we built a single DKF to manage the learner experience. The issue with this approach was each task established in our model was dependent on the other (i.e., one task would initialize on the basis of another task closing). The limitation we recognized was the requirement for a learner to return to the training starting point if the app required a refresh of any sort. To address this, we decided to supplement the entire training experience across six separate courses, where the mobile app would present each course as if they were naturally part of the training intervention (see Figure 3). This created an encapsulated course with six separate interaction lessons. However, each lesson is represented as an individual course, as informed by the GIFT ontology of course terminology.

Figure 3: GIFT Mobile Home Screen for the Land Navigation Terrain Walk Training Experience

With the infrastructure in place to support a sequenced flow of GIFT courses, where each one builds upon the other, the next is establishing the course flow and DKF instantiations for each identified lesson. This requires interaction within two separate GIFT toolsets. The first is establishing the flow of interaction using GIFT's Course Creator (see Figure 4). The Course Creator is used to build a sequence of course objects that dictate the experience. There are a number of course objects available to a GIFT developer, with objects that support the presentation of information, the administration of surveys and tests, the delivery of content, and the management of practice opportunities through scenarios and problem sets.

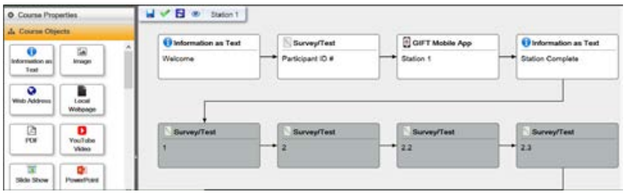


Figure 4: GIFT Course Creator Interface with Station 1 Configuration

With respect to the land navigation use case, each of the six stations depicted in Figure 3 follow the same set of course object sequences to guide the learner experience. This involves providing contextualized information welcoming the learner to the selected station, a survey put in place to collect a learner's participant number, a GIFT Mobile App course object that designates the gateway and DKF to use for training, and contextualized information notifying the learner the station is complete, along with instructions on what to do next (e.g., refresh the app and load the next station).

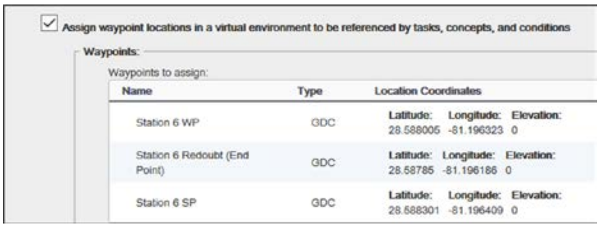
It's worth noting that there are multiple survey course objects greyed out at the bottom of Figure 4. These surveys are established within the course using GIFT's survey composer (see Figure 5). This tool allows an author to build questions sets with scoring logic that can inform performance states during a training scenario. In terms of course flow, these objects are deactivated with respect to their use within the course as their own separate interactions. This function populates GIFT's survey database, which can be referenced while building a station's oriented DKF, enabling the use of these questions as assessment items triggered by GIFT logic built within the Mobile App Interaction.

Figure 5: GIFT Survey Authoring Tool Used to Build Terrain Walk Assessment Items Used During Training

4.1.1. Configuring Interaction within GIFT's Domain Knowledge File (DKF)

With a set of course objects in place, and surveys built to support assessment practices, next is configuring the mobile app. The primary interactive component of each lesson is encapsulated within the GIFT Mobile App course object. To build the mobile app object, two things are required: (1) establishing the training environment/gateway that will dictate the data sources captured during the training event (i.e., GPS location in this case), and (2) establishing the DKF called upon when the course object is activated. For this specific use case, six total DKFs were required, as the course was dissected into six independent interactions. To build each DKF, GIFT's Real-Time Assessment authoring environment was used.

The first component to building a DKF to support land navigation training in a mobile context is establishing scenario properties that are referenced by tasks (i.e., potential start triggers) and assessment conditions for task-related concepts. In this instance, we populate designated GPS coordinates provided in the storyboard that are used by GIFT to drive the learner experience (see Figure 6).



☑ Assign waypoint locations in a virtual environment to be referenced by tasks, concepts, and conditions

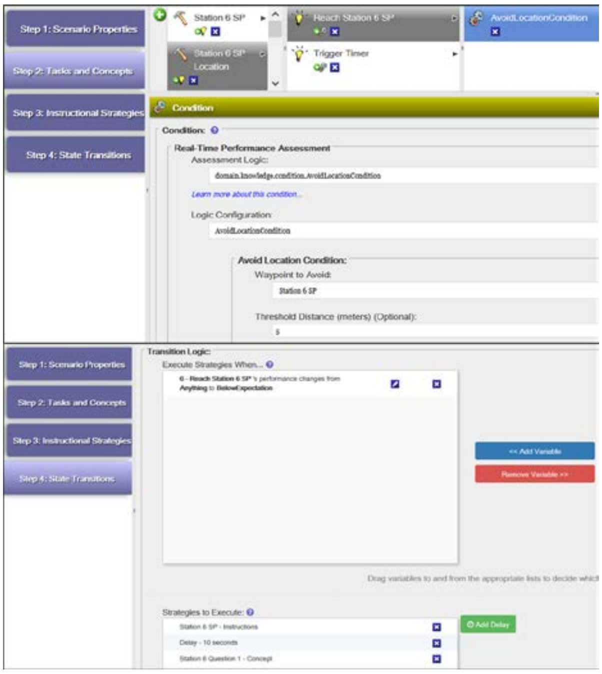
Waypoints:

Waypoints to assign:

Name	Type	Location Coordinates
Station 6 WP	GDC	Latitude: 28.588005 Longitude: -81.196323 Elevation: 0
Station 6 Redoubt (End Point)	GDC	Latitude: 28.58785 Longitude: -81.196186 Elevation: 0
Station 6 SP	GDC	Latitude: 28.588301 Longitude: -81.196409 Elevation: 0

Figure 6: Waypoint References Populated in the DKF's Scenario Properties for Station 6 Start Point (SP), Station 6 Waypoint (WP), and Station 6 End Point (EP)

With the scenario properties populated, the next requirement is establishing the tasks a learner will execute, the concepts being assessed within each task, and the conditions used for assessing performance across the populated concepts. One mechanism that needed to be addressed was building in location oriented triggers that are used to notify the learner of an activity, along with providing the logic to present questions. As seen across Figures 7 and 8, there are two tasks represented within the DKF schema: (1) Station 6 SP Location and (2) Station 6 SP. The first task (see Figure 7) is associated with tracking a learner's movement and notifying GIFT when that learner reaches a designated location. The 'Avoid Area' condition class was used to support this function. Based on the configuration, if the learner comes within 5 meters of the defined Station 6 SP (see Figure 6), GIFT creates a state transition message that signifies the condition has been met. This state transition property is then linked to an instructional strategy selection, where GIFT executes a string of actions when the established condition is recognized. In this instance, when the learner enters that waypoint, GIFT presents station instructions, gives the learner 10 seconds to ready the content, and then presents the first question that requires the learner to execute an activity.



Condition:

Real-Time Performance Assessment

Assessment Logic: domain.knowledge.condition.AvoidLocationCondition

Logic Configuration: AvoidLocationCondition

Avoid Location Condition:

Waypoint to Avoid: Station 6 SP

Threshold Distance (meters) (Optional): 5

Transition Logic:

Execute Strategies When...

6 - Reach Station 6 SP's performance changes from Anything to BelowExpectation

Strategies to Execute:

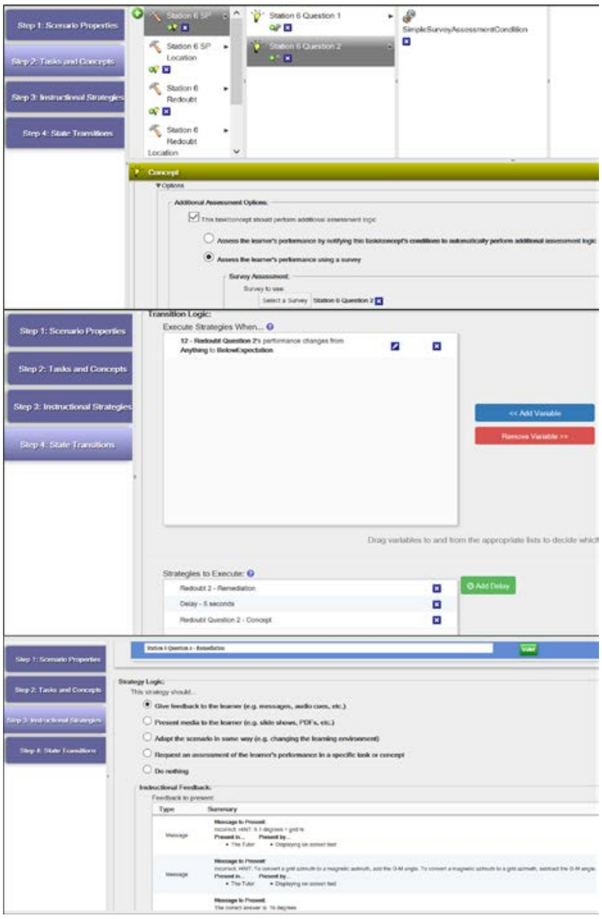
Station 6 SP - Instructions

Delay - 10 seconds

Station 6 Question 1 - Concept

Figure 7: The task and concept structure in the DKF for tracking location, creating state transition messages when concept conditions are met, and configuring what instructional strategies to execute when the transition is observed

The next task represented in the DKF associates with question-based assessments that inform performance on a set of concepts (see Figure 8). Within this representation includes: (1) the designation of a pre-authored survey to present that was established to assess a concept and infer performance, (2) state transitions that dictate pedagogical approaches when certain performance states are observed, and (3) a set of feedback strings or media content to display when the defined state transition is observed.



☑ This task/concept should perform additional assessment logic

○ Assess the learner's performance by notifying this task/concept's conditions to automatically perform additional assessment logic

● Assess the learner's performance using a survey

Survey to use: Station 6 Question 2

12 - Redoubt Question 2's performance changes from Anything to BelowExpectation

Redoubt 2 - Remediation

Delay - 5 seconds

Redoubt Question 2 - Concept

● Give feedback to the learner (e.g. messages, audio cues, etc.)

○ Present media to the learner (e.g. slide shows, PDFs, etc.)

○ Adapt the scenario in some way (e.g. changing the learning environment)

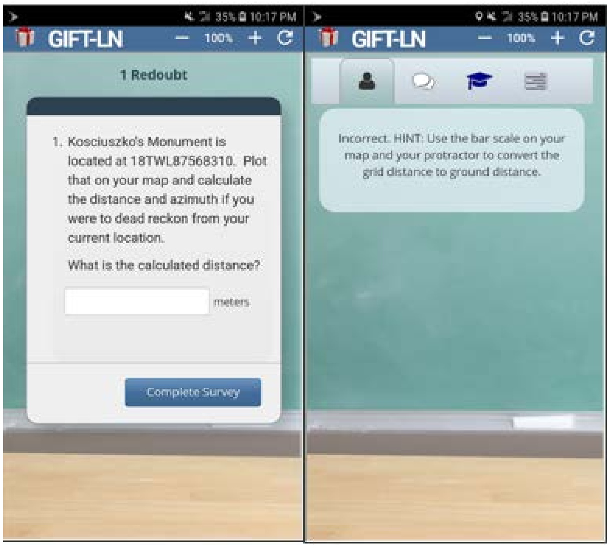
○ Request an assessment of the learner's performance in a specific task or concept

○ Do nothing

Figure 8: The task and concept structure in the DKF for presenting a question, state transition messages based on question performance, and what instructional strategies to execute when the transition is observed

In this instance, because the learner reached the SP, GIFT presents instructions and then displays a question. The question is designed to require a learner to use the tools provided to execute a task contextualized by their surrounding environment. For Station 6, a waypoint is provided to the learner and they are required to plot the point on a map, measure the distance to that point from their current location, and calculate an azimuth they will hold when executing the defined route. This is accomplished by using a map, protractor, and compass to gather the necessary information. Each question in GIFT is designed to gather input on the required concepts needed to effectively perform the task, with specified feedback that targets misconceptions and erroneous inputs.

The question referenced in Figure 8 requires the trainee to input the azimuth from their location to the assigned waypoint. If the answer provided by the learner falls outside the acceptable threshold, a below-expectation transition state is produced, which in turn triggers a feedback strategy. In this instance, the feedback strategy is designed to present a single string of text, as defined by the instructor, to the learner, followed by a re-presentation of the question. The feedback strategy allows for escalation of detail, where an author can build in layers of feedback if the question is continually answered incorrectly. While a single example has been reviewed in the previous paragraphs, this process is required for across all stations, all tasks, and all associated concepts. As an example of the learner interface on the app, Figure 9 shows a screenshot of GIFT Mobile presenting a question regarding the distance of a landmark from the top of a lookout. If the answer is inferred as incorrect, feedback logic is presented, followed by a new attempt to answer the question.



1. Kosciuszko's Monument is located at 18TWL87568310. Plot that on your map and calculate the distance and azimuth if you were to dead reckon from your current location.

What is the calculated distance?

Incorrect. HINT: Use the bar scale on your map and your protractor to convert the grid distance to ground distance.

Figure 9: GIFT's mobile interface a learner interacts with while executing the land navigation Terrain Walk exercise

The process described in this section was repeated across all tasks and concepts for all associated stations outlined in the Terrain Walk storyboard. With a completed app in place, DMI supported the execution of a pilot study to gauge the reaction and impact of this form of technology insertion into the traditional training cycle.

4.2. Training Pilot Study

With a fleshed out prototype of the GIFT Mobile App, DMI approved an initial pilot study to gauge the impact of this new technology when compared to traditional approaches. This provides a control condition we can compare the mobile app interaction and performance outcomes against. While the control does not provide explicit measures we can use to compare performance outcomes, we administered pre- and post-tests to all new cadets that assessed their ability to execute the foundational skills the Terrain Walk targets. We also have access to the new cadet performance outcomes on the day five qualification event.

In the experimental treatment, a group of twenty new cadets were randomly selected from their company (i.e., approximately 160 new cadets) and outfitted with a GIFT configured Android device. The participants were provided a 2.5 hour window to complete as much of the course as possible, with the route extending over 2.5 miles. Over the course of a four-day window, we consented 142 new cadets. We are currently working with the data to extract and prep it for analysis and model builds. The outcomes will be highlighted in future reports.

5. CONCLUSION

In this paper, we review the development and authoring processes required to make a mobile GIFT app focused on land navigation training. To build the resulting prototype, modifications to the GIFT architecture were required to support interaction across cellular networks, while interfacing with smartphone displays. The design requirements and authoring workflows were described for a specific use case, but each process described is generalizable and can extend to multiple domains that incorporate movement and interaction in a live operational environment. With a functioning mobile GIFT app, a pilot study was designed to gauge the technology impact. Future efforts will focus on app enhancements and modifications based on the weaknesses identified in the pilot-test event. In addition, the app will be expanded to support pedagogy during the practice opportunities provided on a specific land navigation course where a learner is left to execute on their devices.

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