

Design Recommendations for Intelligent Tutoring Systems

Volume 11
Professional Career Education



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A Book in the Adaptive Tutoring Series

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Dedicated to current and future scientists and developers of adaptive learning technologies

CHAPTER 10 – CONSIDERATIONS IN CONSTRUCTING AN INTELLIGENT TUTORING SYSTEM FOR SENSITIVE TOPICS: ADAPTING THE PAL3 FRAMEWORK FOR SUICIDE PREVENTION TRAINING

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Introduction

Constructing an intelligent system for training an academic topic such as physics or algebra is formidable but building a training system for sensitive topics such as suicide prevention, where users may be emotionally involved, is even more challenging. Some of the issues include privacy — users may not want to share sensitive information if they think it may be shared with superiors or others; adaptation — people may be motivated to get suicide prevention training for a variety of reasons, such as helping themselves or helping someone else, which means that the training will be most effective if it is tuned to the needs of a particular user; interaction tone — a matter-of-fact interaction style may be very appropriate for academic content, but a more sensitive, and non-stigmatizing tone for interaction may be needed for sensitive topics; and finally, availability — users need easy access to content so that it may be used if a crisis occurs. We sought to use the Personal Assistant for Lifelong Learning (PAL3) framework to build a training system for suicide prevention. PAL3 already had some of the desired capabilities, such as availability, since it runs on iOS and Android smartphones, but a number of additional enhancements were required. In this chapter we briefly discuss the suicide problem in the military, outline the PAL3 framework, and discuss enhancements we made to the PAL3 framework as we developed a system for suicide prevention training.

Background

Based on recent Centers for Disease Control statistics, the occurrence of suicide in the United States has become a serious public health crisis (Centers for Disease Control and Prevention, 2021). Within the general civilian population, many more Americans die by suicide than homicide. While homicide is the 16th leading cause of death, suicide ranks as 10th, with one American dying by suicide every 11-minutes (Drapeau & McIntosh, 2020). Moreover, suicides have been rising nationally in the United States since 1999 with half of the states seeing more than a 30% increase in suicide rates from 1999 to 2016 (National Center for Injury Prevention and Control, 2018). Suicide is also one of the leading causes of death among young people. In 15–24 year-olds it is the third leading cause of death and ranks 2nd in the 25-34 year-old cohort.

These numbers are particularly concerning when considering young service members in the military. Despite unprecedented suicide prevention efforts undertaken in the United States Department of Defense (DoD), suicide rates among military service members remain elevated relative to the pre-9/11 era. Suicide is the 2nd leading cause of death in the military (Armed Forces Health Surveillance Center (AFHSC), 2012). The most recently reported suicide rate for active-duty military was 25.9 deaths per 100,000 population (Tucker et al., n.d.). There has been a per-year increase in the suicide mortality rate ratio (RR) since 2011 among active-duty service members (per-year RR=1.04; CI=1.02-1.05). Despite advantages in access to health care, mental health care, employment, and exercise compared to the general population, service members experienced equivalent increases in suicide rates compared to the US population

(Tucker et al., n.d.). Furthermore, while the most recent suicide rate for active-duty service members is similar to the rate in the US general population, military rates observed in recent years differ dramatically from decades of historic trends where military suicide rates were consistently much lower than the general population (Eaton et al., 2006). For example, from 1990 to 2000, the US military suicide rates were 11.82 to 12.98 per 100,000 population, 25-to-33% lower than the US civilian population (Eaton et al., 2006). This is like many decades of prior military research (Eaton et al., 2006; Rothberg & Jones, 1987). In the Department of Veterans Affairs, suicide prevention is also a top clinical priority. U.S. Veteran suicide rates have also been rising in recent years, and the Veteran suicide rate is currently 1.5 times the rate of the non-Veteran US population (U.S. Department of Veterans Affairs, 2020). Thus, the need for improved suicide prevention practices in the military has become an issue of critical concern. While there are many pressing medical and mental health matters to address among Service Members and Veterans, suicide prevention is a top priority for the DoD.

State of the Field and Supporting Research

To address this priority, the DoD and Veterans Administration (VA) have implemented a variety of classroom/web-based programs that have primarily focused on training leaders and clinical care providers in strategies for better recognizing the signs of suicide risk and in the provision of interventions to their at-risk subordinates or patients. For example, the Ask, Care, Escort Suicide Intervention (ACE-SI) has been the gatekeeper component of the Army's suicide intervention strategy (U.S. Department of the Army, 2015). The primary goal of this program has been to train Army leaders E6 and above to identify peers at risk for suicide and safely accompany them to a helping resource. ACE-SI aims to challenge leaders to engage using Motivational Interviewing skills (Ask), offer support and assistance through common factors strategies (Care), and safely implement supportive action by accompanying them or directing them to the appropriate helping resource (Escort).

The Navy Leader's Guide for Managing Sailors in Distress (Navy Medicine, 2021) provides Navy leaders with psychoeducational materials that address mental health and wellness and includes a module on suicide prevention. The VA's Safety Planning Intervention is designed as a brief clinical intervention that healthcare providers can implement with Veterans at risk for suicide. At risk patients are identified as those who may have made a suicide attempt or engaged in other types of suicidal behavior, reported suicidal ideation, have psychiatric disorders that increase suicide risk, or who are otherwise determined to be at risk for suicide (Stanley & Brown, 2012). This approach teaches clinicians how to conduct a structured interview that aims to help patients identify their emotional warning signs or triggers and to formalize a plan of action (or behavioral contract) for reducing their subsequent suicide risk (i.e., identify internal coping strategies, specify social, family, friend, and professional contacts, and in the encouragement of harm reductions strategies). These programs represent a strong effort to teach leaders and healthcare key principles for recognizing and supporting those at risk for suicide. However, complimentary strategies are needed to provide service members and veterans similar psychoeducational knowledge, self-awareness, and suicide prevention tactics directly.

In the past, suicide prevention training was delivered mainly as a group lecture in a classroom. There are several problems with this approach that our work seeks to overcome. The lecture setting necessitates a one-size-fits-all approach to content. The group setting makes it very difficult to adapt training in response to individual learner needs or motivations. Classroom training is delivered periodically, which means it may not be available outside of class or when it is most needed. Finally, the classroom setting may discourage students from asking questions about sensitive topics or revealing their concerns.

PAL3 Framework

The PAL3 framework (Swartout et al., 2016) was designed to provide learners with an adaptive, always available learning environment to promote learning outside of the classroom. The design of PAL3 follows four core principles:

- *Useful Learning*: Recommend learning content that is relevant to the learner's goals and needs.
- *Personalized Learning*: By analyzing learning pathways, recommend topics and lessons that maximize learning rates and mitigate skill decay.
- *Engaged Learning*: Leverage techniques from the learning sciences, games, and social media to create engagement and learning over time, even when between traditional classes and training.
- *On-Demand Learning*: By leveraging mobile learning (e.g., smartphones), content is always with a learner, whenever and wherever they are, including making content available when offline.

An overview of the PAL3 framework is shown in Figure 1. The Learning Record, built on the Veracity Learner Record Store (LRS) framework (lrs.io), stores learners' past training experiences and how they did, their mastery of relevant topics, and their goals. The Resource Library holds a variety of different types of learning resources. These can include HTML websites, videos, models and simulations, interactive computer tutors, and even other apps. PAL3 can make use of a broad array of existing resources. In most cases it is not necessary to create special content for PAL3. To add content to the Resource Library and make it usable by PAL3, usually all that is required is to add metatags to the content indicating how much active exploration the resource involves (further described in the next section) and what knowledge components the resource can help a user learn. These metatags are used by the recommender, described below. Because PAL3 may need to be used in situations where online connectivity is not available, PAL3 can download and cache resources for offline use, including local versions of resources (e.g., videos, static web pages, quizzes, tutoring dialogs).

Two of PAL3's core capabilities are the Recommender and its Engagement mechanisms.

Recommender for Lessons

The Recommender uses the information in the Learning Record to adaptively recommend learning exercises to the user. Recommendations are based on three factors, which each require an increasing amount of information about resources to apply.

1. *Novelty*: The recommender prefers resources that the learner has not already seen, which is done by calculating a familiarity estimate based on the number of exposures to the resource so-far. The novelty factor requires no metadata about a lesson, enabling limited adaptivity even with arbitrary resources.
2. *Exploration*: The second factor is how much active learning and degrees of freedom the learner needs to benefit from the resource. The exploration factor is a single number, representing a continuum meant to represent distinctions such as Passive / Active / Interactive / Constructive (Chi & Wylie, 2014). Passive resources such as videos or simple web articles are assigned the lowest exploration level. More open-ended have high exploration levels, such as interactive simulations or model construction, where the user has a large space of options or complexity to manage. If a learner's mastery of a topic is low, the recommender prefers passive resources with more

knowledge components (overviews) and low-exploration active resources with fewer knowledge components, while more active resources will be recommended for those with greater mastery.

3. *Deficits:* Learning resources are tagged with the knowledge components (KC) (Alevan & Koedinger, 2013) they can address, while the Learning Record expresses mastery in terms of KCs. Learning resources that can address specific learner deficits are preferred.

The learner is presented with the recommended resources and is free to either follow the recommendation or navigate to some other learning resource. Users engage with their selected resources, resulting scores are recorded in the learning record and the whole process iterates.

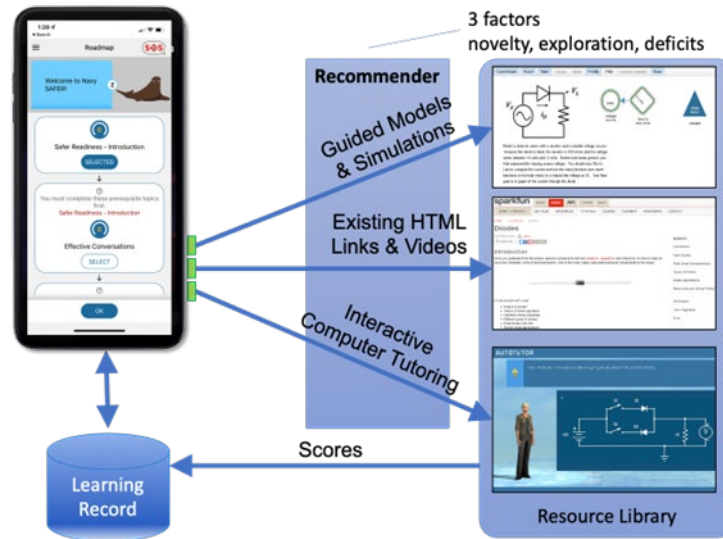


Figure 1. PAL3

Engagement Mechanisms

The engagement mechanisms for the framework follow three primary types: mastery learning, effort self-regulation, and social learning. These align directly to the three main panels: Goals, Study Pace, and Teams. The Goals panel provides an open learner model showing the learner's progress toward mastering the current topic and their larger goal. Open learner models help with metacognition about learning and skill levels, which have been shown to produce engagement and learning gains (Long & Alevan, 2017). The Study Pace panel enables learners to set a target for daily study time, to help them regulate their study pace over the week. This is inspired by fitness tracking apps, such as Fitbit step tracking. The Teams area allows learners to opt-in to a team, which competes against other teams for king-of-the-hill for each topic. This enables a collaborate/compete dynamic, where members within a team are incentivized to support each other's learning while competing against other teams. This structure is central to many social games and social media programs, which produce sustained engagement (Pirker et al., 2018; Shonfeld & Resta, n.d.).

PAL3 Evaluations

We have conducted two controlled evaluations of the PAL3 framework. The first study, which used Microsoft Surfaces rather than smartphones, showed that PAL3 significantly reduced knowledge decay among Sailors about electronics (Hampton et al., 2018). The second controlled study showed significant learning gains in leadership knowledge with junior Navy officers (16% gain from pre to post; $N=24$;

$p < 0.001$; effect size 0.76). Topics studied included communication and counseling, leadership, making adjustments for moves and family life, and initial content for suicide bystander training.

Approach

Individuals at risk of suicide will not always be identified if we depend exclusively on traditional in-person mental health clinic visits. This is underscored by findings in a recent 2021 review (Tang et al., 2021) that found that "...the majority of people who die by suicide have never seen a mental health professional or been diagnosed with a mental illness." The authors go on to suggest that online interventions, including mobile apps and online psychotherapy appointments, having shown preliminary success, may be a useful option for reducing suicidal ideation and for breaking down barriers to treatment such as physical distance and stigma. Moreover, suicidal actions often involve stressors and losses that add to long-building stress (Ho et al., 2018). As a result, interventions to strengthen protective factors and reduce vulnerabilities to high stress can reduce risk of suicide and other destructive behaviors.

To address this issue, the PAL3 framework was adapted to develop SAFER, the Safety Assistant for Excellence and Resilience. SAFER was designed to align to US Navy suicide prevention efforts, which include broad-based general military training (GMT) to build skills and understand available resources. However, suicide prevention skills and goals vary widely between different people, due to the history of and current level of experienced stress, concerns about friends or family, or the persons need to act as a leader to build social supports. As a result, personalized learning is important for each individual to build the skills and mindset that is relevant to how they can recognize and reduce suicide risk.

Compared to earlier PAL3 training domains such as electronics or leadership skills, SAFER suicide prevention presents unique challenges for personalized learning that required significant changes to the PAL3 framework. The four challenges were: Relevance and risk estimation, Content for prevention, Plans on how to apply skills to a real situation, and Privacy of sensitive data. These represent additions to the PAL3 framework and also required modifying or disabling earlier capabilities not appropriate for SAFER's use cases.

Relevance and Risk - Adaptive Intake Survey and SOS Button

Fairly quickly when designing SAFER, we recognized a key concern: what if a Sailor comes to the app because they are currently at high risk? This is a non-trivial issue and ties in tightly with privacy issues, since Sailors would be less likely to be frank and open with a system that will report back on them. The decision was made to search for potential risk factors and, if identified, suggest ways to reach out for help. This was accomplished by an initial intake interview with the pedagogical agent, which asks about reasons for visiting the system and about different types of risk factors.

The first question in the suicide prevention interview determines if they are ready to complete the survey, if they have concerns about completing it, or if they came because they need immediate help (Figure 2a). If they indicate that they need help, we open the Safety Button, also called the SOS button (Figure 2b). The Safety Button opens a content tree which can be navigated by clicking through the tree options or by searching for content. The Safety Button area can also be opened to directly display a specific piece of content, as is shown below. The resource gives clickable phone numbers for suicide hotlines, crisis chat links, and suggestions about how to increase safety against self-harm. Content in the Safety button is unique in that it is nearly always available via the upper right-hand button, even when offline (all associated content is downloaded). While the content in the Safety Button is currently limited to seeking help and helping others, this could be expanded to be context-sensitive to the current training goal and

could be used to offer a fast way to search for just-in-time skills (e.g., reminders on how to perform CPR). If they indicate they are not comfortable completing the survey, we ask for their reason and in that process, they can also return to complete the survey. For each option they select in the survey, the system adds or subtracts counters from a set of attributes. These attributes are:

- Self-At-Risk: Risk factors for harm to self (overall)
- Others At-Risk: Risk for others (e.g., concerned for a friend)
- Prevention: Interest in prevention in general (e.g., a leader)
- Disengaged: Response pattern shows lack of attention
- Negative Feelings: Feeling depressed, hopeless, anger, etc.
- Stress: Indicates high levels of stress and stress-related issues
- Sleep Issues: Poor sleep quality and fatigue
- Exercise: Lack of physical activity
- Social Support: Feeling a lack of social network or help
- Unsecured Guns: They have unsafely stored firearms
- Suicidal Ideation: Indicates thoughts or consideration of suicide (can trigger SOS Button)

The survey is adaptive, where questions are displayed or hidden based upon the current levels of attributes. For example, if the user shows high Self At-Risk early in the survey, we open additional questions to ask about Suicidal Ideation and suggest ways to seek help. However, if they show low risk and we have not directly asked if they had Suicidal Ideation, we ask that near the end of the survey, just to be sure we do not miss asking this critical question. This enables the survey to emulate an interview by asking additional questions about areas of concern, while keeping the questions for each learner brief (e.g., about 5 minutes).

The questions in this survey are primarily based on established clinical surveys for assessing risk factors such as mood disorders, sleep problems, and suicide risk. These short and well-validated screening measures include: 1. The Generalized Anxiety Disorder scale (Spitzer et al., 2006); 2. The State-Trait Anxiety Inventory (Spielberger, 1989); 3. The Patient Health Questionnaire-9 (Depression) (Kroenke & Spitzer, 2002); 4. The Beck Hopelessness Scale (Beck et al., 1988); 5. The Insomnia Severity Index (Morin et al., 2011); and 6. The PTSD Checklist-M (Blevins et al., 2015; Weathers et al., 2013).

New questions were also added to directly align to the learning topics available, such as questions about prior experience and confidence in applying skills from certain topics. Additionally, questions for social support and reasons for using the system were created ad-hoc, due to these being tailored toward Navy Sailors.

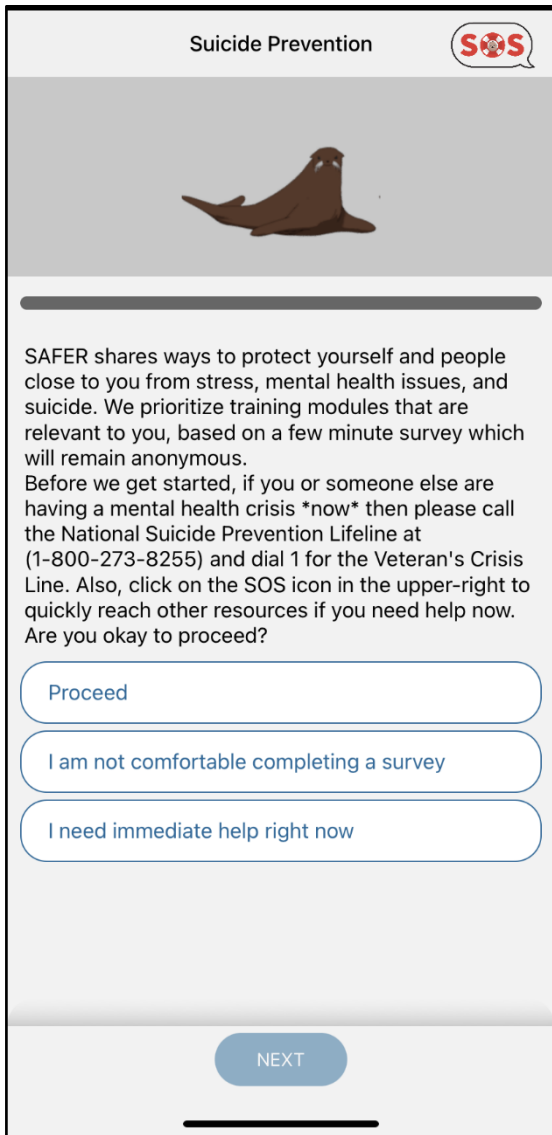


Figure 2a: Intake Survey (First Question)

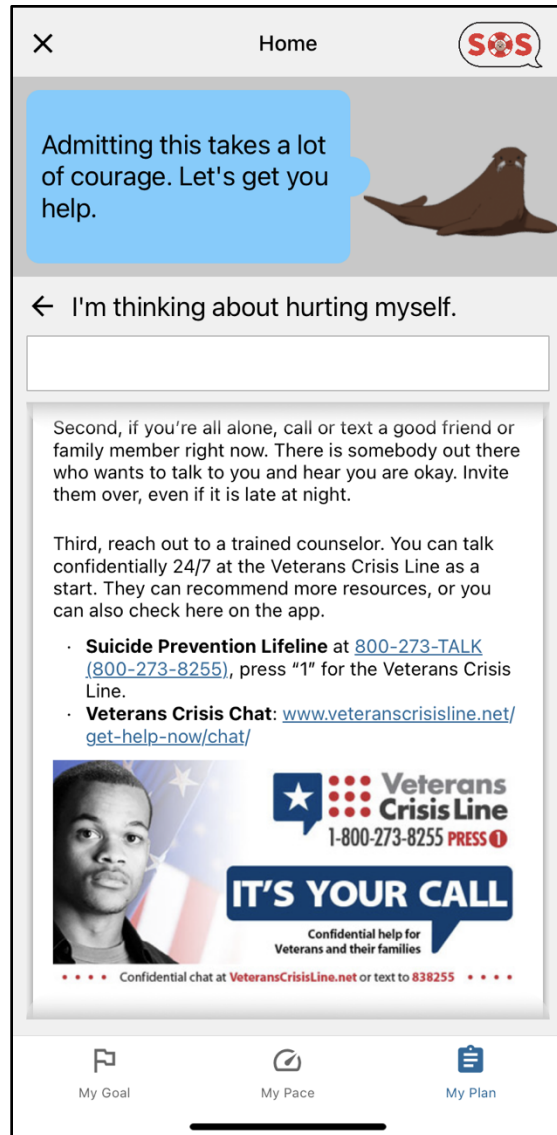


Figure 2b: Safety Button/SOS Suggesting help

When the survey is complete, their responses to questions generate a personalized roadmap for learning topics based on their interests and risks that are relevant to them (Figure 3). This roadmap considers three factors: relevance based on attributes, if the topic was mastered already (if any prior resources), and prerequisites for topics (which topics should be mastered before others). As a result, the roadmap updates to reflect prior learning and show the current priorities. For a new learner, the attributes determine the initial roadmap. Each topic can have weights associated with attributes, which may be positive (more relevant) or negative (less relevant). These enable calculating a weighted sum for the relevance of a topic to the learner, based on their attribute profile from the survey. This is expected to increase engagement and usefulness of the content, by providing the most relevant topics first.

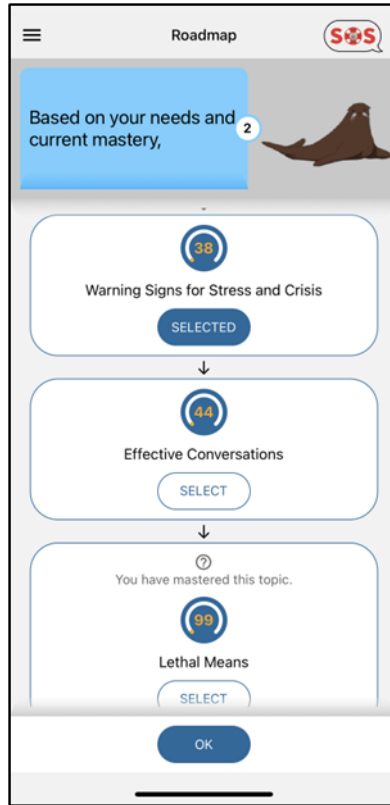


Figure 3. Personal Roadmap

Content for Prevention - Planning Ahead for Safety

The core content for SAFER is aligned to the Navy's General Military Training (GMT) content for suicide prevention, which is managed by Navy N17, the 21st Century Sailor program. However, further structure was required to organize the training into topics with a prevention focus. The unifying theme was "Planning ahead for safety" where Sailors build skills, mindsets, and behaviors that increase resilience and reduce stress so that if a major stressor or loss occurs, they have greater readiness. Inspiration for learning content was informed and adapted from a variety of well-vetted web-delivered sources including: National Institute for Mental Health (National Institute for Mental Health, 2022), Navy Leaders Guide for Managing Sailors in Distress (Navy Medicine, 2021), National Center for PTSD (U.S. Department of Veterans Affairs, 2021) and Beyond Blue (Beyond Blue, 2022).

As part of this structure, Sailors are introduced to the concept of the suicide Safety Plan, a tool designed for clinicians to help a person at-risk to understand and plan ahead for the people, resources, and strategies that they can use when they notice their own warning signs (Stanley et al., 2008). In SAFER, as a clinician is not available, the Safety Plan is treated as a practice opportunity: familiarity with the tool should assist them in working with a clinician if needed and even for Sailors who may never need a safety plan, it offers a concise outline of key prevention skills. The Veterans Administration Safety Plan template (U.S. Department of Veterans Affairs, n.d.) has seven sections which can be summarized as: Personal warning signs, Internal coping strategies, People and places for healthy distractions, People to contact for help, Professional help for a crisis, Making a safer environment/home, and Reasons for Living.

The topic areas in SAFER mirror these sections, consisting of:

- Introduction to Safety Planning: Summarizing the reasons for planning ahead, the role of proactivity reducing risk factors and stress, and the concept of a safety plan.
- Warning Signs for Stress and Crisis: Identifying physical, behavior, and emotional warning signs in yourself and in others.
- Quick Coping Strategies: Physical tools (e.g., breathing) and cognitive tools (e.g., disrupting cognitive distortions and dysfunction patterns of thought) to reduce risk.
- Stronger Support Networks: Recognizing different types of social support, understanding your support network, and building stronger support networks.
- Reaching Out (to professional help): Overcoming barriers to help-seeking and understanding the professional resources available in the Navy.
- Effective Conversations (talking to others at-risk): Practicing how to reach out to others and talk with them supportively and productively.
- Lethal Means: Understanding why securing methods of suicide can reduce risk long-term and understanding the best options to secure the guns in their household.

Each topic contains multiple types of resources, typically starting with a non-stigmatizing and motivating rationale (e.g., a video or infographic) followed by a review which may include a multiple-choice quiz or an OpenTutor (Nye et al., 2021) conversational tutoring lesson. After skills are introduced, practice activities are presented until the learner shows mastery of the topic. In the current topics, to keep learners moving through the material smoothly, the current set of lessons are calibrated to help learners reach mastery without frustration (e.g., simpler assessments, low repetition). By comparison, some prior PAL3 subject areas included more challenge problems or simulation-based practice. These more challenging practice opportunities may be appropriate for future content, which depends on mastery of foundational topics. For example, topics that were considered but which were not integrated were Emergency Response (recognizing an acute crisis and helping connect them to care), Command Climate (leadership strategies to improve social support and help-seeking), and Postvention (leadership steps to prepare for and respond to a death by suicide).

In addition to adding content, some systems of PAL3 were modified to support SAFER. As part of a synergistic research effort, the COPE Tutor was developed to support use-cases such as suicide prevention content. The COPE Tutor is a substantial expansion of the OpenTutor framework, an open-source project which delivers authorable and incrementally improved open-response tutoring dialogs. COPE was developed to address needs observed when shifting PAL3 tutoring dialogs from the electronics domain to areas such as leadership and peer pressure. During this shift, it was noted that direct feedback was often inappropriate for sensitive topics (e.g., a learner says, "It would be hard because I would be depressed." and then the tutor says "No. That's not right."). Systematic changes were made to the OpenTutor dialog system, such that dialogs could be specified as "Sensitive" vs. "Traditional". This also involved changes to symbols and color schemes, to avoid "red for wrong" but instead using more neutral tones for corrections. Compared to the Traditional dialog policy, Sensitive dialogs avoid strong negative feedback, tone down positive feedback (e.g., avoid "Great!"), provide more encouraging prompts, and optionally provide a "survey says" board to focus attention more on the correct answers rather than on the feedback. While a separate evaluation is determining the impact of these changes, initial testing indicates that they enable meaningful dialogs on more sensitive topics that might be too callous using a traditional more direct tutoring approach.

Planning Ahead - Incrementally Building a Safety Plan

In addition to using the Safety Plan to help structure content, the training also helps the learner develop their own personal safety plan. While this plan would not be near the level of a plan developed with a well-trained clinician, this safety plan helps them think about how they would leverage protective factors and strategies in their own life. It also can be exported and shared as a PDF, in the case that they might need it in the future as a starting point for a professionally-aided safety plan or to share with a bystander during an unexpected crisis.

Building a safety plan required three additions to develop SAFER. First, a new main area in the PAL3 framework was developed ("My Plans", as shown in Figure 4a). This area allows any PAL3 goal to be associated with one or more "plans" which can be accessed as fillable forms. Plans may be as simple as a single field (e.g., a "Notes" form) or can involve multiple sections which accept text, phone numbers, locations, and other fields. The Suicide Prevention goal has one plan: the Safety Plan.

Within each topic, one or more special "Planning" lessons can be added. These resemble conversational tutoring lessons, but rather than assessing responses and giving tutoring feedback, they ask for information to help complete a section of a Plan (Figure 4b). Each answer can be associated with custom validation, to help users to improve their response if it is likely to be unsuitable (e.g., too short, invalid phone number). Each Planning lesson in SAFER is based on question prompts adapted from the VA Safety Planning guide for clinicians and associated short-form guides with additional question prompts (Stanley et al., 2008). It must be emphasized that this is not close to emulating a professional. While an actual therapist would know the client's history, help them think about scenarios where they felt warning signs, and ask about barriers to certain strategies, the SAFER planning dialogs are comparatively shallow and meant to encourage reflection and an initial draft of planning. After the Planning dialog is complete, the learner is asked if they want to update their Safety Plan based on their responses. Each dialog completed fills out a section of the plan, as shown in Figure 4c.

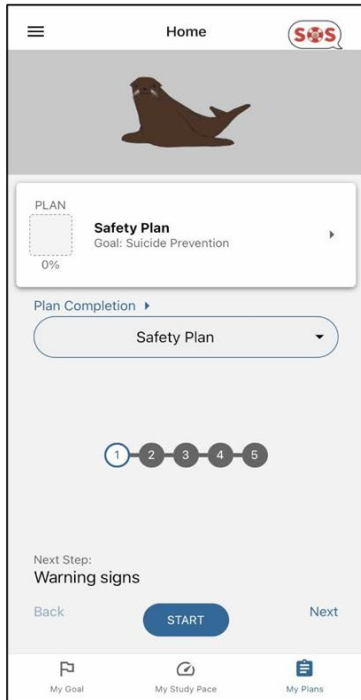


Figure 4a: Safety Planning.

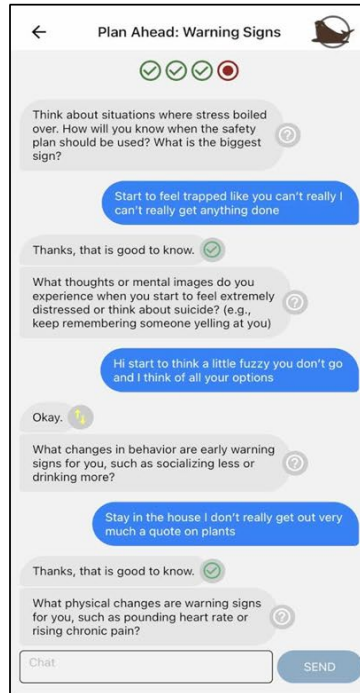


Figure 4b: Gathering Info

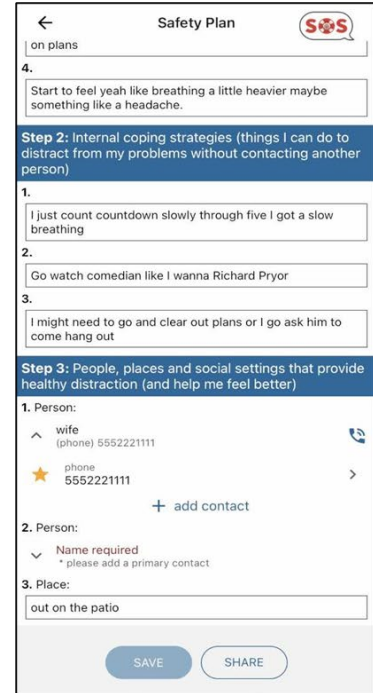


Figure 4c: Safety Plan

Privacy of Sensitive Data - Local Storage and Controls

During the design of these features and content, privacy and sensitivity of data was a key issue. Privacy considerations are particularly sensitive in a military setting, because health issues (including sometimes mental health issues) can impact a Sailor's readiness to serve in certain jobs, roles, or even remain in military service. While this is uncommon in practice, since the military invests heavily in each member and tries to return them to service, concerns about career repercussions can delay Sailors from seeking mental health services or make them careful to choose services with clear policies about disclosure (Ho et al., 2018). As a result, it was decided that a high degree of privacy and personal control over information would be the default for the system.

A three-tiered privacy model was chosen for the current version of SAFER:

1. User ID-Linked: When starting the app, learners can make an arbitrary user ID based on any available email, to enable discretion over how easily that can be tied to a specific person. This ID is associated with data such as which resources are completed and for certain persistent settings (e.g., study pace).
2. Local-Only: Other data is only stored locally on-device. If the user creates an account on a new device, they must manually re-enter it (though in the future, a method to manually transfer it is planned). This data includes the attributes calculated after completing an intake survey and the contents of the Safety Plan.
3. Non-Persistent: Finally, some data is not stored after entering. This includes the responses given to the intake survey and any responses in a planning dialog where the user does not update their local safety plan.

Thus, maximally sensitive data is not stored long-term (such as specific survey responses). Sensitive but less-specific data is stored only on-device, with no server storage or synchronization. The remaining data is relatively non-specific, such as which resources the learner has completed. This is not particularly identifying, in that all resources will eventually be recommended, and learners have the option to start with any topic they choose, regardless of the recommender system order. Additionally, to retain greater privacy, the PAL3 Teams area was disabled for SAFER so that learners train individually. While there could be cases where cohorts were appropriate, it was decided that testing with users to better understand their privacy considerations and preferences would be required before enabling or adapting this feature.

By prioritizing privacy, we expand access: more users should be able to trust that they can use SAFER, and they will be able to use the app more authentically. In addition, SAFER offers quick access to crisis hotlines and other tools to help both bystanders and individuals who are at-risk. However, there are downsides to this level of privacy. Even if a user answers with high-risk responses, we are not able to automatically notify a human to contact them. Moreover, even if we wanted to, the data that a user provides would be insufficient to know their phone number or location to reach them. As a result, we can only trigger the SAFER coach and Safety Button to suggest seeking help from friends or hotlines. We expect that this should be appropriate for the level of risk that users have when actively in the system (e.g., that an acutely suicidal person would not be likely to spend their time in a learning/training app). However, it is still a limitation of the way the app is currently designed.

Future versions of the app will hopefully be able to further tune the privacy and data management. One added level of security would be to further de-identify User ID-Linked data in the app, so that only one system component is possible to make that connection. This would facilitate an organization (e.g., the Navy) to analyze patterns of system usage without any meaningful user ID's (i.e., only arbitrary ID mappings), for an additional layer of security and privacy. A second addition would be to combine the current Safety Button triggers, which occur when high risk is detected, with a notification system that allows a user to accept or reject directly calling a crisis hotline or similar human connection. By further reducing the friction to reach a trained human helper, this should increase the likelihood that a person with acute risk can get help.

Discussion

Most intelligent tutoring systems have been developed to run on laptops or desktops. The instructional content is typically drawn from some academic discipline such as algebra, electronics or physics. The tutoring systems are often used as an augmentation of a classroom experience. Students may be challenged, bored, or engaged by the content, but the content itself is not a risk for students. As we developed SAFER, we found that we were moving into a very different space that required us to make changes from the usual approach to intelligent tutoring systems.

First, we recognized that people using the system could have very different motivations for seeking suicide prevention training. They might be concerned about helping a friend or loved one with suicidal thoughts, or they might be having suicidal thoughts themselves, and there are various risk factors that they or others might have. This wide variability meant that a single path through the content was not likely to be effective and led us to create the initial survey to elicit users' motivations and risks. Second, SAFER is designed to run on mobile devices, which means it is always available. While increased availability is good, it also means that people may use it when they are away from instructors or classmates. That could be problematic if the person were feeling suicidal or became suicidal while using SAFER. That is why the initial interview that we added to the PAL3 framework in creating SAFER not only assesses a user's motivations for using the system, but it also assesses their risk and if the risk is high enough suggests that they need to seek counseling with a real human and makes it easy to contact help.

Thus, the initial interview is not only finding out more about the learner so that the learning experience can be customized, but also suggesting that they stop using the app and seek counseling if they seem at high risk. This is not something that typically happens in intelligent tutoring systems but is necessary for this domain.

Third, we were concerned that if users felt their data might be shared with others, particularly supervisors, people would be reluctant to use the system. To allay those concerns we designed the systems so that all personal data stays on the user's device. Elements such as the safety plan are only shared with others if the user decides to share them, and the default is not to share.

Fourth, the fact that some users might be confronting high stress and other risk factors meant that the system responses to user inputs had to be couched to reflect potential user sensitivities. A simple "right" or "wrong" response that might be acceptable in a conventional training system needed to be modified to be more supportive and nuanced.

Recommendations for GIFT and Intelligent Tutoring Systems

Several key aspects of the PAL3 framework are relevant to tutoring systems such as the Generalized Intelligent Framework for Tutoring (GIFT), which can deliver both web-based training for desktops and connect with team simulations. First, SAFER targets a use-case where adaptive mobile training is used as personalized training that is intended to complement in-person team training (e.g., an on-site GMT training session). While SAFER uses this pedagogy for suicide prevention training, training for squad level simulations could use the same general design: personalized competency-building → team training exercise → goal-setting for team and individuals → additional personalized training. Depending on the training goals, this pattern could be used for multiple different team training designs such as: a) Collaborative Learning: having each member of a team learn different things to share in-person, b) Common Ground: establishing a baseline of prerequisites prior to team training, c) Role-Based Training: practicing skills that are relevant to only one role within a larger group, and d) Goal-Setting: following team training, set personalized practice goals that will improve each member's contribution to the next team training.

Second, persistent mobile adaptive learning such as SAFER can provide continuity across many different team training environments. This is important, because a common concern among military learners is that they train extensively but often lack easy ways to re-visit and review material later when it is needed.

Finally, as intelligent tutoring systems expand into new domains, such as mental health, we believe that it will be important to support capabilities from PAL3 such as an initial survey that enables up-front, persistent personalization and also data-sensitivity settings that determine which data is shared versus kept private/local for the user.

Conclusions

In this chapter, we have discussed the changes that we found necessary to make to the PAL3 framework as we moved from domains that intelligent tutoring systems typically cover such as electronics or leadership to suicide prevention training. The resulting SAFER system currently exists as an advanced prototype ready for evaluation.

It is important to note that the SAFER approach is not designed to replace the care of a live provider. Rather, it can fill a gap where a live provider is not available or where the user is hesitant to speak with

one. This gets at the core of what is needed most to engage troubled service members who are resistant to or disengaged from mental healthcare services (but who are in the most need and perhaps at the highest risk of suicide). The ability to leverage a mobile application that can help enhance service member resiliency via systematic access to critical self-awareness building and psychoeducation content, offers such a safety net. Although SAFER is not a substitute for live professional care when needed, it can provide a complement to that care--and, unlike real human clinicians, mobile apps are always available, never tire, have ready access to an extensive library of relevant learning resources, and maintain a steady and consistent presence. Moreover, with additional software enhancements, the PAL3 system could assemble a knowledge base of a users' issues through repeated interactions with users that could be used to guide further development of suicide prevention content. Thus, whether to fill a gap in absent care, or serve as its complement, the potential for PAL3 to reach all service members in support of their mental health needs offers a pragmatic and pro-social example of the potential benefits of intelligent tutoring systems.

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