An Investigation of the PERvasive Learning Systems Impact on Soldiers' Self-Efficacy for Self-Regulation Skills

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The current study an empirical evaluation of the PERvasive Learning System (PERLS). PERLS is a mobile microlearning platform designed for learning anytime and anywhere, taking advantage of planned and unplanned time during a learner's daily schedule to enhance and reinforce learning. Soldiers taking classes from the Sabalauski Air Assault School at Fort Campbell, KY were recruited. This evaluation compared the impact of PERLS on soldiers' self-efficacy for their self-regulated learning ability. This evaluation found evidence of impact for the PERLS when implemented into classroom setting with soldiers that used PERLS indicating higher self-efficacy scores.

INTRODUCTION

Technology is rapidly transforming how people learn and how we provide training. For example, in higher education, there are estimated to be nearly 6.7 million students enrolled in online education courses (National Center for Education Statistics Fast Facts, 2019). This transition has placed more of the burden of learning on students. Supporting self-regulated learning (SRL) could be a solution to this problem. Self-regulated learning (SRL) refers to iterative learning processes wherein individuals make plans, set goals, attempt to complete tasks, monitor their progress, and adapt to improve (Azevedo, 2009; Panadero, 2017). However, learners, especially lower ability learnings, often do not have SRL skills (Winne, 2005) that would support them during online learning. The current study investigates a mobile microlearning system that supports learners' self-regulated learning influence learner's self-efficacy for their SRL ability.

PERLS and PERLS development

The Pervasive Learning System (PERLS) is a mobile microlearning platform designed for learning anytime and anywhere, taking advantage of planned and unplanned time during a learner's daily schedule to enhance and reinforce learning. It is a government-owned platform that uses advanced algorithms to provide tailored learning recommendations to personnel based on their characteristics, learning history, training requirements, and context. This allows distributed, self-regulated, context-aware, personalized learning.

PERLS has advanced from an R&D prototype on IOS without an authoring system (Freed et al., 2017) to a robust system moving toward transition for use to support learning and training organizations within the government ecosystem. From Float's development effort, the current system has expanded to reliably work on desktops by a browser-based system as well as mobile-based Apps for Android and IOS that work on both phone and tablets. These systems have been independently user tested with both formative expert evaluation and summative user-based testing to ensure the system was up to standards and read for transition. This will result in a learning technology system that is mobile, content agnostic, stable and scalable, empirically validated, technically documented, and designed for transition to sustainment.

Microlearning

Mobile-based microlearning is a recommended method for supporting modern learning ecosystems (Craig & Schroeder, 2020). Mobile learning has been shown to improve student participation, achievement, and learning (Suartama et al., 2019). Microlearning is a learning approach based on small learning units and short-term focused activities (Hug et al., 2006; Lindner, 2007; Nikou & Economedes, 2018). They are normally less than five minutes in length (Jahnke et al., 2020).

Self-Regulated Learning

Self-regulated learning theory decomposes learning processes into recursive phases that are enacted strategically and intentionally to improve performance (Alexander et al., 1998; Winne, 2011; Winne & Hadwin, 2008). A task definition phase describes students' efforts to understand the pertinent problems, and available resources. A goal setting and planning phase has students establish objectives and select tools and strategies to meet those objectives. An enactment or engagement phase describes how students implement and choose strategies as well as attempt to perform the task. Finally, in an evaluation or adaptation phase, students assess their actions and outcomes, and make efforts to revise their goals, plans, and strategies.

When students are unguided (i.e., receive minimal strategy instruction or supporting scaffolds), they are typically poor at regulating their own learning (Winne, 2005)—they overestimate their abilities (Kruger & Dunning, 1999) and content understanding (Glenberg et al., 1982). As a result, students without strong SRL strategies need additional scaffolds to guide them through the process. Without guidance, the student flounders (Kirschner et al., 2006).

Existing studies have considered the role and assessment of metacognitive monitoring and regulation in learning from multimedia, hypermedia, and educational technology (e.g., Azevedo et al., 2010). Such studies consistently link self-regulatory strategies to improved learning and performance when studying in distributed multimedia environments. Moreover, these studies demonstrate how self-regulation strategies can be taught or encouraged through various scaffolds (e.g., Azevedo & Cromley, 2004), and have demonstrated interactions between self-regulation and cognitive factors (e.g., prior knowledge; Taub, Azevedo, Bouchet, & Khosravifar, 2014) and motivational factors (e.g., achievement goals; Duffy & Azevedo, 2015).

Learning Strategy in PERLS

PERLS integrated Mobile microlearning and Self-Regulated Learning into one application (See Figure 1 for example). The system supports SRL at a macrolevel. Planning is supported through goal setting and topic selection It has search, discover (drill down topics), and a recommendation engine to support research identification. PERLS has several search features including a global search for content and a Discover feature based on the recommendation engine. Enacting is supported by PERLS content cards (e.g., article cards, flip cards, and tip cards). The system supports reflecting with the recommendation system using quiz cards and flip cards after content has been learned. Microlearning is enacting at a microlevel of the content created by the system. This is supported by articles cards and quiz cards. These allows for micro-content of small, chunked courses to be create and parted with quiz cards to give instant feedback (Craig & Schroeder, 2020; Jahnke et al., 2020).

Figure 1. Stages of self-regulated learning with examples of PERLS support.

Current study – Hypotheses

Because the PERLS systems supports the users self-regulated learning processes with extra practice and scaffolding provided PERLS the system could impact users' self-regulation abilities. It is predicted that the scaffolded supports in PERLS will led to increased self-efficacy in self-regulation ability for users of PERLS over participants that do not receive the support.

METHOD

A randomized control trial was implemented to evaluate the usage and impact of PERLS within a live classroom setting. Participants were recruited from soldiers taking four classes of the Sabalauski Air Assault School at Fort Campbell, KY. The Air Assault training consists of three phases. Phase one was main lecture and introduces soldiers to the basics of air assault. Phase two provides training on rigging cargo loads for rotary wing aircraft. Phase three is main physical training. This project only focused on phase one and two. At the start of each class, the research team recruited learners in the class, collected consent, pretest data and applied the preset randomization scheme to place participants into conditions (Control or PERLS). Soldiers in the control condition received their Air Assault course as normal with some additional training on resilience and an overview of self-regulation. Soldiers assigned to the PERLS condition were given a link and instructions on how to access the PERLS system in addition to receiving their standard Air Assault course. All participants were contacted via email at the end of Phase 1 and Phase 2 to complete posttest measures. The data from the current paper is part of the data collected from the larger study.

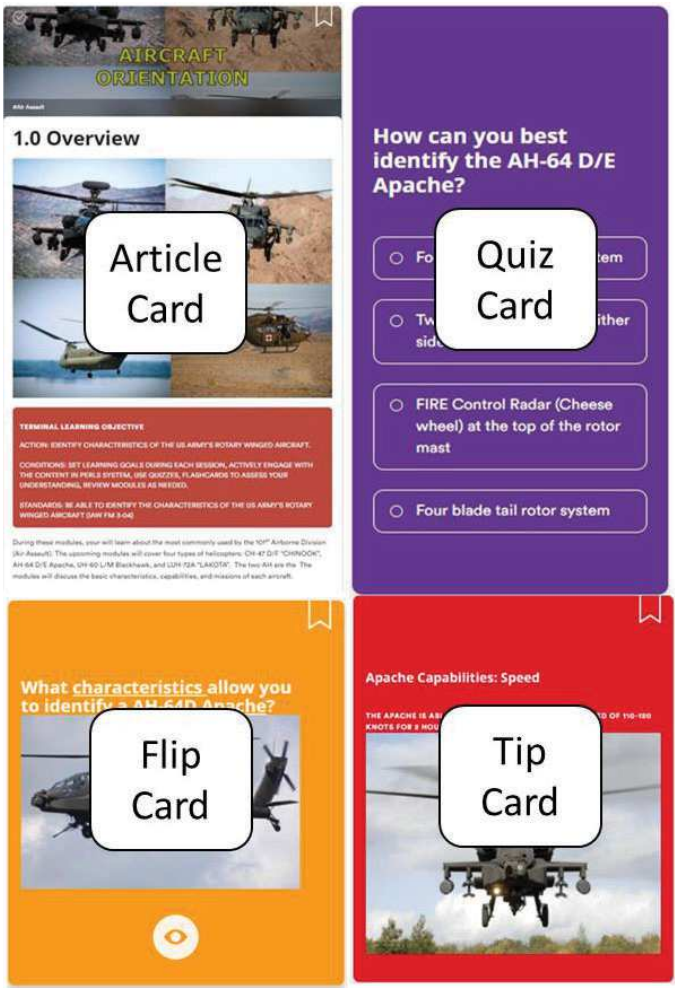

Figure 2. Screenshots from the PERLS material.

Participants

This study recruited 441 soldiers from four classes. A total of 16 participants were removed from analysis due to retaking the course and being assigned to another multiple conditions (5) or for dropping out of the class before any data was collected (11). This resulted in 425 soldiers participating in the final study. These soldiers were randomly assigned to either the interactive systems condition (PERLS) or the control condition (classroom + SRL and resilience training). This resulted in 215 soldiers assigned to use PERLS and 210 soldiers assigned to the classroom control. However, there was treatment adherence issues in the study with soldiers not complying with their assigned conditions. Thirty-four soldiers assigned to the control signed up for PERLS accounts. It should be noted that only 18 of the 34 used PERLS. Additionally, there were treatment adherence problems in the treatment condition of the 215 soldiers assigned to the PERLS condition, only 87 used PERLS during the study with 128 never opening PERLS. Because of this treatment adherence effect in the data, conditions based on treatment dosage would be more appropriate for answering the research questions. This resulted in 320 soldier that did not use PERLS and 105 that used PERLS. Additional treatment adherence problems occurred during posttest with only many participants not completing the out of class posttest measures. Only 25 participants completed both pretest and posttest measures to be included in these analyses.

Materials

PERLS - Interactive system condition. For the interactive system condition, participants interacted with PERLS as an add on to their Air Assault training. The PERLS content covered the material from Phase 1 and 2 of the course. The content was created by the ASU team using Air Assault class PPTs, instructor guidance packets for each topic and the course handbook. All content was vetted by ADL instructional designers and Air Assault instructors from Fort Campbell. Content design. The content was created to use all aspects of PERLS. This included Articles cards, Flash cards, tip cards, two 100 item self-assessment tests, and the Air Assault handbook divided up into subsections. All content in PERLS was created based on content that was also available to students only taking the class. So, this condition was informationally equivalent to the classroom condition. PERLS content was created following best practices based on science of learning recommendations (Craig & Schroeder, 2020). Examples of these include using deep level multiple choice questions with immediate feedback, reinforcement learning with flashcards, as well as articles that have visual organizers and links to provide contiguity for learning and short amounts of bit sized information (Craig et al., 2020; Jahnke et al., 2020).

Classroom only condition. For the classroom only condition, participants took their class as normal. However, they were also given additional training on resilience and self-regulation during learning. This content was identical to the content provided to students within the PERLS condition. However, it was provided as a supplemental online PDF. All interaction within this condition will be between the participant and human instructors serving as the multiple roles.

Self-efficacy. A version of the Chen, Gully, & Eden (2001) General Self-Efficacy Scale will be used at pre and posttest to determine participants self-rated efficacy for completing the task. This test has eight items and is measured on a 5-point scale. The scale was modified to assessed learner's self-efficacy toward their self-regulation. This measure was given at pretest and posttest.

Procedure

Soldiers were recruited using a short in person presentation within classrooms. Each soldier was given a research packet that included a consent form, initially instructions, pretest version of the self-efficacy scale, pretest version of the SRL scale, and an instruction page on next steps depending on their condition. Soldiers in the PERLS conditions were given instructions on downloading and creating an account in PERLS. Soldiers in the control condition received a link that gave them two power point files on Self-Regulated Learning and Resiliency. It was up to participants to follow links and instructions provided. The participating soldiers were contacted again via email the day before the phase two assessment with links to the post measures.

RESULTS

An ANCOVA was conducted on soldiers' post self-efficacy for self-regulated learning ability using pretest self-efficacy measures for SRL as covariates to determine any difference between condition and classes. This test indicated a significant difference for the PERLS usage, $F(1, 16) = 6.16$, $p = .02$; $\eta_p^2 = .28$, but not for class or the interaction. Soldiers that interacted with PERLS ($M = 4.13$, $SD = .63$) had significantly higher self-efficacy than soldiers that did not interact with PERLS ($M = 3.62$, $SD = .55$) (See Table 1). It should be noted that these results could be bias due to the low sample size and the attrition in the study.

Table 1.

Means, Standard deviation and N for posttest Self-Efficacy for SRL PERLS usage condition.

	Mean	Std. Dev.	N
Classroom	3.62	.55	7
PERLS	4.13	.63	18
Total	3.98	.64	25

DISCUSSION

It was hypothesized that because the PERLS systems supports the users self-regulated learning processes with extra practice and scaffolding provided PERLS the system could impact users' self-regulation abilities. We found support for this hypothesis. Our prediction that scaffolded supports in PERLS will led to increased self-efficacy in self-regulation ability for users of PERLS was supported.

This finding is encouraging because self-regulations skills have been difficult to train (Winne, 2005). Self-efficacy refers

to an individual's belief in his or her capacity to execute behaviors necessary to produce performance (Bandura, 1986; 1997). Self-efficacy had been shown to directly impact motivation which leads to skill transfer (Chiaburu & Marinva, 2005). Elevated self-efficacy increases the intent to perform the learned skills so that the next step of performing the strategy is more likely to be initiated (Machin & Fogarty, 1997). So, the increased efficacy from training with a system that support self-regulation during learning observed in this study could lead to increased usage of SRL strategies in the future.

Limitations

As with any large-scale study conducted within the real world, implementation of this study was not perfect. The current findings while interesting should be considered within limitations of the problems with the study. The two major limitations are discussed below.

The posttest measures obtained at the end of Phase one and Phase two suffered from low response rate. This low response rate had two potential impacts on the measures. First, the low sample size could be causing a type II error masking any effects due to not enough statical power to find reliable differences. Second, the drop out also has the potential for selection bias problems that could have cause a restricted range in the data where only the persistent and potentially better students completed assessments. The means for these measures were in the predicted direction with PERLS usage condition higher than the non-usage condition and drop out analysis did not indicate a difference between conditions.

However, a problem was observed with the treatment adherence of this study. Specifically, over half of the soldiers assigned to use PERLS did not use the system. This does allow for the potential of unequal groups which led to the observed findings in favor of PERLS. However, the evaluation of the pretest data indicates that this is not very plausible. Conditions were equal on pretest knowledge, initial self-efficacy on the ability to learn the topic, initial self-efficacy on their ability to self-regulate, and on a pretest for a separate Self-Regulation Scale. This would argue that the groups are equivalent enough to allow some amount of trust in the observed post learning measures. However, these results should still be considered preliminary and additional evaluation are needed to establish the stability of the observed effect.

Based on these findings, it appears that working with a system that provides supports for self-regulating learning can improve learners' perceptions of their ability self-regulate their learning for an adult military population. The evidence from this study should be viewed as preliminary with additional research needed. This finding provides additional evidence to the notion that technology properly used can support SRL (Azevedo & Hadwin, 2005; Winne & Stockley, 1998) when SRL support elements are present within the technology (Azevedo et al., 2010).

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APPENDIX

Self-Efficacy for Self Regulated Learning tasks
Modified from Chen, Gully, & Eden (2001)

1. I believe I will be able to achieve most of the goals for tasks associated with Self-Regulated Learning that I have set for myself.
2. When facing difficult tasks associated with Self-Regulated Learning, I am certain that I will accomplish them.
3. In general, I think that I can obtain outcomes related to Self-Regulated Learning tasks that are important to me.
4. I believe I can succeed at most any endeavor related to Self-Regulated Learning tasks to which I set my mind.
5. I believe I will be able to successfully overcome many challenges related to Self-Regulated Learning tasks.
6. I am confident that I can perform effectively on many different tasks related to Self-Regulated Learning.
7. Compared to other people, I can do most tasks related to Self-Regulated Learning very well.
8. Even when things are tough, I believe I will be able to perform tasks related to Self-Regulated Learning quite well.