# Training Older Adults to Use Public Information System: Effects of Medium and Instruction Type on Training Efficacy

Technology training design for older adults is important as well-designed training methods can greatly improve technology accessibility for them. While there exist general design guidelines, such as supporting self-paced and goal-oriented training and using step-by-step instructions, additional design knowledge needs to be developed and validated empirically to further improve technology training design for older users. In an effort to contribute to the current design knowledge base, this study investigated the medium and instruction type effects on the efficacy of training older adults to use a public information system (a public ticket machine). Four training methods, combinations of 2 medium types (paper, digital) and 2 instruction types (goals-only, goals-and-actions), were evaluated in a lab experiment. While the older participants' task performance generally increased after training, the degree of improvement differed significantly between the training methods. The combination of digital medium and goals-only instructions showed the highest performance improvement resulting from training.

## INTRODUCTION

Designing proper instructions and training for older users is considered important for improving technology accessibility for them (Czaja et al., 2019). Indeed, in spite of different challenges faced by older adults in learning to use new technology, they indicate that they would be more comfortable with and willing to adopt new technologies if they received some type of formal training (Rogers et al., 1996). Thus, well-designed training methods may lead to higher adoption of new technologies by older users. In particular, in the context of using public access systems, as many older users have little or no practice using them, providing simple on-site training or tutorials can make these systems more universally usable (Sengpiel, 2016).

Related to technology training for older adults, different training methods, including text descriptions, graphical tutorials, video instructions, and interactive tutorials, have been compared. Some previous findings are as follows: among different representation methods, graphical tutorials resulted in higher efficacy compared to textual tutorials (Digmayer & Jakobs, 2012). In terms of training media, interactivity was found to be an important factor to enhance the training effect (Bruder et al., 2007; Toyota et al., 2014). As for designing training content, it was reported that older adults preferred guided or goal-oriented training to unguided lessons (Jan et al., 2012).

Also, despite the fact that best practices are often dependent on the target population and the task or skill to be trained (Czaja et al., 2019), general guidelines for designing an effective training program for older adults have been established. Fisk et al. (2009) recommended minimizing cognitive demand and providing appropriate and immediate feedback during training so that older adults can learn by trial and errors. Also, procedural skills should be delivered in a step-by-step format since older adults prefer to learn to perform task steps rather than gain a general understanding of the system (Leung et al., 2012). The step-by-step format may also be advantageous in that dividing the training into short lessons would help motivate older users through immediate successes (Fisk et al., 2009). In addition, goal-oriented and self-paced training is considered effective as older adults generally prefer to learn on their own with guided training materials and sufficient time (Mitzner et al., 2008; Leung et al., 2012). In sum, the aging and training literature suggests designing goal-oriented and self-paced training with step-by-step instructions for older adults.

Despite the previous research efforts, however, there still remain knowledge gaps; and, thus, additional design knowledge needs to be developed and validated to further improve technology training design for older users.

One such knowledge gap was found in the context of designing an on-site training module to be integrated into public ticket machines. Instructions for on-site training can be designed in different ways – they may contain much information, including descriptions of the goal (what-to-do) and related actions (what-to-click) for each step, or they could be concise giving only the goal (what-to-do) for the step. Also, different types of medium, such as paper and digital, could be employed in providing training. The knowledge gap pertains to the questions: what is the best instruction type for step-by-step instructions that maximizes training efficacy? Does the best instruction type change across different training medium types?

Related to these research questions, Hickman et al. (2007) assessed the relative benefits of two instruction types: the guided action training (giving actions only) and the guided attention training (giving goals only). The guided attention training was found to yield better performance in transfer tests, particularly for older adults. However, the study did not consider multiple medium types; nor did it examine the type of instruction giving both the goal and related actions for each step.

The objective of the current study was to examine the effects of training methods on the efficacy of training older adults to use a public information system (a public ticket vending machine). In particular, four training methods, which are the combinations of two medium types (paper, digital) and two instruction types (goals only, goals and actions), were comparatively evaluated in terms of the training impacts on task performance and user workload.

## METHOD

### Participants

A total of 64 older adults (thirty males and thirty-four females) participated in this research study. Their ages ranged from 60 and 69 years (M = 64.5). All participants were free of obvious musculoskeletal disorders and had normal or corrected to normal vision on both eyes. Also, the prior experience using public kiosks and technology competency were carefully scrutinized in advance. In an attempt to examine the effects of training methods particularly for novice users, older adults with none or little experience using public ticket machines were recruited.

### Experimental procedure

The experimental task was booking a train ticket using a public ticket machine. In each trial, the participants were given a sheet on which train information for the trial was written, and they were instructed to book a train ticket that completely matches the given information. Two kinds of booking applications of similar user interfaces (App A, App B) were utilized. The action sequences required to book a train ticket as well as the layouts of the main user interface components of the two Apps were similar. The log data, which contained information including interaction time, screen indices, and touch coordinates, were collected using a Python script.

The participants were randomly and equally assigned to one of four groups and completed a total of five task trials. Among the five task trials, the third one was a self-paced training session where the participants had to complete the ticket booking task on App B following the given training material and instructions. The first and second trials were designed to assess baseline performance for Apps A and B, respectively. The fourth and fifth trials, to assess performance for App B and App A after the training in the third trial, respectively. The post-training performance assessment without access to the instructional materials can be interpreted as transfer measures, which provide an index of learning (Schmidt & Bjork, 1992). While the training was conducted only on App B, performance measurements before and after the training were conducted both on Apps A and B. The ability assessment of untrained tasks in the same domain (App A) was conducted to evaluate how participants could generalize their trained knowledge (Hickman et al., 2007). During the four non-training sessions, the participants had to complete the ticket booking task without access to the training materials. The experimental procedure required about 60 minutes for each participant (Figure 1).

### Design of training methods

The current study comparatively evaluated four different training methods, which were the combinations of the levels of the two variables: 4 = two levels of medium × two levels of instruction types.

Concerning medium, the two types of medium were paper (P) and digital (D). The paper manual was non-interactive and offered a step-by-step guided tour by text instructions with screenshots of the application on a sheet of paper. During the training session, the participants had to complete the task by reading and following the instructions written on the paper manual. On the other hand, the digital manual was an interactive tutorial where instructions were provided directly on the screen. During the training session, the participants using the digital manual had to perform operations by reading and following the instructions written on the screen.

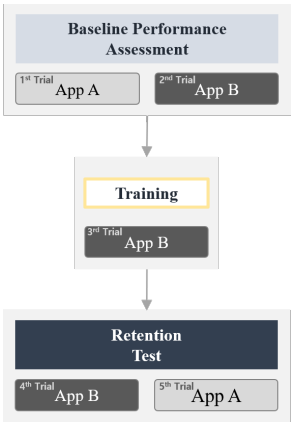


**Figure 1.** Experimental procedure

As for instruction type, one of the two levels was giving only the goals to be accomplished at different steps (goals only; what-to-do), whereas the other was providing goals and also associated actions (goals and actions; what-to-do and what-to-click). Before the onset of the training session, the participants of the goals and actions group were instructed to pay attention to additional graphical indications on the screen. Figure 2 illustrates the four training methods employed in the study ("P-goals only", "P-goals and actions", "D-goals only", and, "D-goals and actions").

### Independent and dependent variables

In this study, two independent variables (medium, instruction type) of two levels were considered in designing four different training methods. The current study was concerned with investigating the training effects for novice users; and, thus, the independent variables were between-subjects factors.

In each of the performance assessment trials (Trials 1, 2, 4, and 5), the participant's task performance and workload were evaluated. The task performance was measured in terms of time (task completion time) and accuracy (total number of clicks, action sequence length). In addition to the performance measures, the participant's perceived workload was evaluated using the NASA-TLX questionnaire (Hart & Staveland, 1988). Each participant rated the perceived workload for each of the six dimensions of workload (mental demand, physical demand, time pressure, effort, performance, and frustration) immediately after the completion of each trial. Table 1 presents a summary of the dependent variables employed in the study.

For the training session (Trial 3), training time, the total amount of time between the onset of training and completion of the last operation, was measured.

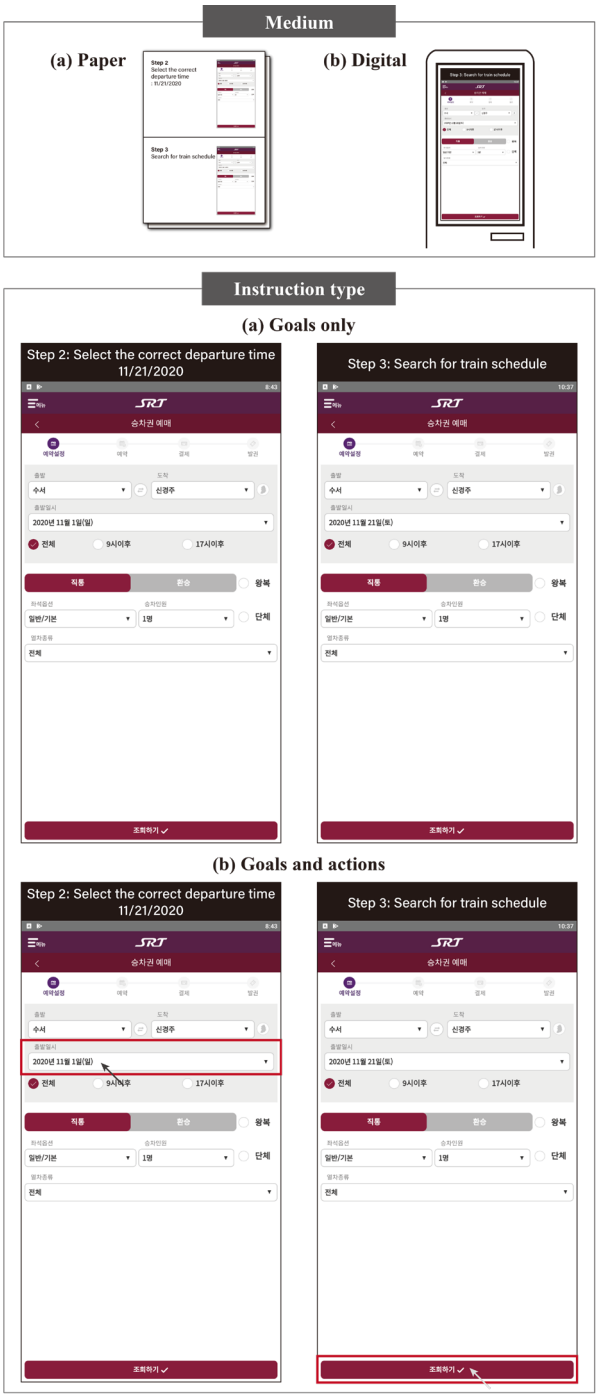


**Figure 2.** Descriptions of training methods

**Data analyses**

Both the task performance and workload before and after the training session were statistically analyzed. First, differences between the mean values before and after training were tested to evaluate the general training effects irrespective of the training methods.

Second, for each dependent variable, a two-way ANOVA test was conducted to examine the difference between the four training methods. Group differences before the training session were tested to verify that the participants' baseline performance did not differ by groups. On the other hand, the group differences after the training session were tested to evaluate whether the training effects differed by groups. The model included two between-subjects factors of two levels (Medium: paper, digital; Instruction type: goals only, goals and actions). In cases where a two-way interaction was statistically significant, post hoc tests with Bonferroni corrections were conducted.

All statistical analyses were conducted using SPSS 25 (IBM Crop, Armonk, USA), and an alpha level of 0.05 was utilized.

**Table 1.** Dependent variables

| Dependent variables | | Definition/Quantification |
|---|---|---|
| Time | Task completion time | The total amount of time between the onset of the trial and completion of the last operation (s) |
| Accuracy | Total number of clicks | Total number of clicks (touch operations) during task performance |
| | Action sequence length | Total number of screens participants went through during task performance (Action sequence length results in the minimum if a participant completes the task following the standard action sequence.) |
| Workload | Mental demand | NASA-TLX questionnaire |
| | Physical demand | |
| | Time pressure | |
| | Effort | |
| | Performance | |
| | Frustration | |

## RESULTS

*General training effects.* Regarding all dependent variables, the mean values before and after training were significantly different. The paired t-test results indicate that the mean values of task completion time, total number of clicks, action sequence length, and average workload were significantly lower after training than before (Figure 3).

*Training method effects.* No significant group differences were found before training. On the other hand, after training, regarding App B, the two-way interaction of medium and instruction type was significant for task completion time ($F(1, 60)=9.325$, $p=0.003$), total number of clicks ($F(1,60)=4.729$, $p=0.034$), and action sequence length ($F(1,60)=5.907$, $p=0.018$). The mean values of "D-goals only" were significantly lower than those of "P-goals only" ($p<0.05$). The largest training impact was found for the "D-goals only" method (Figure 4). Concerning App A, a similar result was found for task completion time ($F(1,60)=10.250$, $p=0.002$). No other significant differences were found regarding the workload measures.

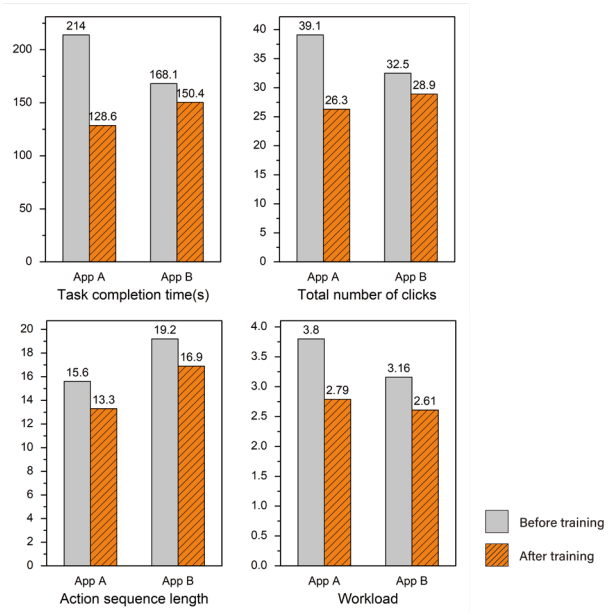


**Figure 3.** General training effects

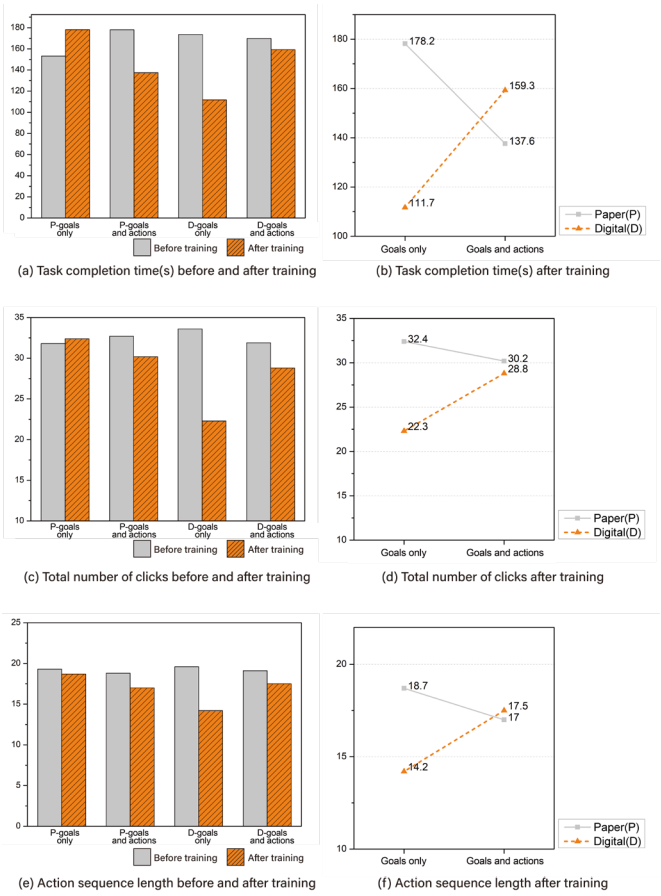


**Figure 4.** Training method effects on App B

*Training time.* The average time spent for each training method was compared. No significant main effects or two-way interaction effect were found regarding training time (Figure 5). The overall average training time was 121.49 seconds.

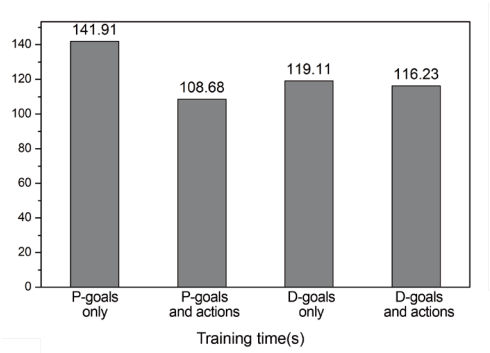


**Figure 5.** Training time

## DISCUSSION

This study comparatively evaluated four different training methods in terms of training efficacy when training older adults to use a public ticket machine. The four training methods were combinations of 2 medium types (paper, digital) and 2 instruction types (goals only, goals and actions). The participants' task performance and workload when using the public ticket machine were evaluated both before and after training. Since training should support learning the task well enough so that an individual can use the system when the instructional materials are no longer accessible (Hickman et al., 2007), except for the training session, participants had to complete the given task without access to the training materials, and the task performance under such condition was evaluated. The findings indicated that: (1) task performance generally increased while workload decreased after training, (2) the degree of improvement differed by the type of training method the participants experienced, (3) The "D-goals only" training method was the best in terms of procedural knowledge transfer, and (4) between the two training methods employing the paper medium, the "P-goals and actions" method was better than the "P-goals only" method.

Concerning all dependent variables, the differences between the mean values before and after training were significant. The participants' performance generally increased after training, and their perceived workload scores decreased irrespective of the training methods. The findings are consistent with the previous result the older user's technology competency can be enhanced by training (Czaja & Sharit, 2012). The study results also seem to lend support to the necessity of providing proper technology training programs for older adults as one of the major challenges faced by them in learning to use new technology is their lack of relevant technology experience (Kurniawan, 2006).

Aside from the general training effects, the degrees of improvement by training were found to significantly differ by groups. Before training, no significant differences in task performance across the four groups were found. This indicates that the participants' baseline competency to use the application was homogeneous across the groups. On the contrary, after training, between-group mean differences in task completion time, total number of clicks, and action sequence length for App B became significant. Since the group differences were significant only after training, they

would logically be attributed to the effects of training method. In particular, the medium × instruction type interaction effect was significant for all three performance measures. In the digital manual condition, it was found that on average, only providing goals to be accomplished in each step (goals only) resulted in shorter task completion time, smaller total number of clicks, and shorter action sequence length than providing descriptions of actions required as well (goals and actions). The results seem to suggest that when designing interactive tutorials, allowing for trial and error by not providing required actions but goals would facilitate learning. That is, interactive training materials would better be designed to require attentional processing by the individual, lest the learner become so reliant on the materials (Hickman et al., 2007). On the other hand, in the paper manual condition, the "P-goals and actions" method resulted in higher performance compared to the "P-goals only" method. This seems to suggest that when the training medium is non-interactive, detailed instructions are more helpful. In cases when it is difficult to provide real-time feedback, specific descriptions may need to be provided to train users.

The significant medium × instruction type interaction effect on task completion time for App A after receiving training on App B is also notable. Considering that training was only conducted on App B, the significant training effect differences on the untrained task seem to support the generalizability of the major finding that the "D-goals only" method is recommended.

It is important to note that age-related changes in cognition do not mean that older adults cannot learn to use new technology. Depending on how well a training program is designed, older adults may have less difficulties remembering newly learned skills. In fact, among different kinds of long-term memory, the degree of age-related declines in procedural knowledge is known to be dependent on how well-learned the procedure is (Czaja & Sharit, 2012). In other words, the procedural knowledge which has been acquired with a well-designed training program would be retained in an older adult's memory without much effort. Moreover, as it also takes longer for older adults to unlearn procedures (Czaja & Sharit, 2012), proper design of training programs of methods is particularly significant for the older population.

In this study, the experimental procedure consisted of five trials of task completion including a training session, and all trials were completed within a day. The training effects of different training methods need to be evaluated more thoroughly to further strengthen the current results. For instance, the evaluation of retention several days after training may be added to data analyses. Also, future studies that compare the four training methods in different task contexts are needed to confirm the generalizability of the current study findings.

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