WHEN DO INSTRUCTIONAL FEATURES BECOME A DISTRACTION?

Dr. Jean A. Pratt, Utah State University, jpratt@b202.usu.edu

ABSTRACT

Would adding instructional elements to minimalist-based instruction increase the rate and retention of learning? Logically, it might be expected that providing learners with additional instructional aids would result in increased learning. Conversely, I found that the additional instructional features actually distracted the learner from the critical instruction, but not significantly. Furthermore, learners tended to skip over anything they perceived as extraneous.

Keywords: minimalism, online instruction, online education, end-users, end-user computing

INTRODUCTION

There is a strong trend in the software application industry, training and education to place instruction online. There are two main reasons for this trend: time and cost. Online instruction can be updated and "published" much more quickly than can hard-copy instruction. This is especially important if your content tends to change often. It is much faster to update and publish one module of instruction than it is to wait and update the entire publication. It's also much less expensive.

Effective, well-written, helpful instruction strongly influences the perceived effectiveness of the software by users (8, 15) to the point that the online instruction can "make or break a software application" (8, p. 7). What are the risks of poor instructional design? Loss of revenue and lack of learning. Inadequate or poorly written online instruction results in user frustration with and possible rejection of the software (12, 13) and possible loss of business (15). The impact of poor instruction in on-the-job training could range from loss of productivity to loss of life. A main goal of anyone developing online instruction is to make it as clear, concise, and communicative as possible in order to increase end-user learning and company revenue.

It is critical to identify which instructional models can be adapted for use in an online setting. One such model is minimalism. Minimalism was developed by Carroll and his colleagues at the IBM Watson Research Center as a "less is more" approach to develop self-instruction modules for new software applications. Carroll's approach was in contrast to the traditional instructional systems design (ISD) approach proposed by Gagne' (7) and used by most instructional designers in the development of training materials. Carroll's impression of instruction designed using the ISD process is that it "is designed with little consideration of the learners and no consideration for the context within which learning will occur" (5, p. 74). Carroll's main complaint about systematic design is the tendency for instructional designers using this approach to break down tasks into minute, detailed components preceded and followed by lengthy descriptions and conceptual explanations (4, 10). Instead, Carroll advocates providing users with just enough information to learn the application as they explore its interface to solve their own problem tasks.

The number and focus of the specific principles of minimalism have changed over the years. The most recent listing by Van der Meij and Carroll (18) condenses minimalism into four principles: (a) choose an action-oriented approach, (b) anchor the tool in the task domain, (c) prevent mistakes whenever possible, and (d) support reading to do, study, and locate.

Problems with Minimalism

The main problem with minimalism is that there are no specific application guidelines for *how* to implement the principles. Hallgren (10) criticized Carroll's book on minimalism, *The Nurnberg Funnel*, for "providing no direct help for me to perform my work" (p. 16). Indeed, Carroll (5) was adamantly against prescribing a "recipe" for creating instruction:

> There is no deductive theory of minimalist instruction; that is, given a set of minimalist principles, we cannot just crank out a training manual. Design never works in this way. What is important is the key idea of minimizing the extent to which instructional materials obstruct learning and of refocusing the designing of training materials on the goal of supporting learner-directed activity and accomplishment. (p. 91)

Without specific "how to" guidelines, practitioners are left on their own to implement the minimalist principles. Educators, trainers, and technical communicators developed a variety of different implementations of the minimalist principles (2, 3, 9, 15, 17), some of which are contrary to minimalism and some of which—although aligned with minimalism—seem so contrary to normal procedure that practitioners are reluctant to implement them.

Relatedly, minimalism was designed for *training manuals*, not online instruction. However, its "less is more" approach is directly applicable to the limited availability of screen space in online instruction. Although Microsoft and Lotus are shifting their help systems to minimalism (2) and some of the leading authors in online help development (2, 3, 6, 9) include minimalism in their guidelines, there is limited empirical research to support such online implementation.

Another problem is that the limited empirical research conducted on minimalism using training manuals resulted in contradictory findings. Carroll (4, 5) and Van der Meij and Carroll (18) cited a number of studies they and others have conducted which have "repeatedly proven the effectiveness of minimalist instruction" (p. 243). However, other studies (11, 14) indicated either mixed results or suggested that minimalism was *not* an effective approach for all types of learners. Even in Carroll's study (5) participants were frustrated to the point of being voluntarily excused from the experiment! Further research, especially in an online setting, is needed.

VARIANCES IN INSTRUCTION

The three versions of instruction used in this research were based heavily on the descriptions provided by Carroll (5) and Black et al. (1) in their experiments with the *Minimal Manual*. Those three help systems are referred to as skeletal, inferential, and elaborative. All the help systems were designed and developed in a similar manner so that any differences among them could be attributable to their purposed differences in design.

Skeletal

The skeletal online help system included all the functions using terse, but explicit definitions and procedural steps. Subjects had to click on hypertext to get definitions. No conceptual or explanatory sections were included in the procedural topics. Subjects learned by doing. Figure 1 (see Author Note at end for url to supporting figures and tables) is an illustration of a procedural topic in the three different versions of online instruction.

Inferential

The inferential online help system started with the skeletal version but provided less information and more encouragement to "reason and improvise" the application's functions (5). The inferential online help system required the learner to attend to the system during the course of learning (5) by providing them with the directions for completing related tasks in "Hints" located at the end of the procedural steps for a base task. For example, Figure 1 shows the steps for a base procedure of formatting text into columns. The related task (in the Skeletal version) of creating a banner heading is located under "Hints" in the Inferential version. By providing related tasks as hints in the same window as the base procedure, users can apply the same knowledge to different, but similar, tasks and see how those tasks are related to one another within an overall goal.

Elaborative

The elaborative online help system is based on the skeletal version of help, but includes the most instructional support available in any of the online help systems.

Explanatory information. Elaborative help topics generally included a two-to-three sentence explanation of *what* the task does and *why* subjects might want to perform it.

Notes. Elaborative help topics included supplemental information in the form of notes. Although not critical to complete the task, notes provided users with helpful information. When the information was relevant to the entire task, then the note was placed below the steps; however, when the note was relevant only to a step within the task, then the note was placed immediately after that step (2).

Graphic feedback. Elaborative help topics included two types of graphic feedback: (a) "Click here for a graphic of …" text, and (b) "What you should see" hypertext located either at the end of the sequence of the tasks or (in the case of a complex task) at appropriate divisions within the task. The graphical feedback used screen captures to confirm to the users that they were or were not in the right place to complete the step or that they had completed the step correctly (19).

Hints. The hints in the elaborative online help system differed from those found in the inferential online help systems. Elaborative hints provided additional information to help the user complete the given task, while the inferential hints encouraged the user to reason out how to complete a similar task from the given task.

METHODOLOGY

Sample and Procedure

All 111 subjects (38, 37, and 36 per group, respectively) for this empirical research had to qualify for entrance by scoring 100% on a Kelly Services Skills Testing of basic MS *Word 97* tasks. Once qualified, they completed a background-information survey to identify their self-reported skill level in specific software applications. Kelly Services personnel then scheduled them for two sessions, one week apart, at the Utah State University computer lab.

Subjects were randomly assigned to one of three different versions of online instruction. During the first session (the first week) subjects used MS *Word 97* to create three similar-looking newsletters as a form of a pretest, treatment, and posttest. During the second session, a week later, subjects created a final newsletter as a form of a delayed posttest. The goal was first to identify comparatively the increase in learning after exposure to each of the different versions of instruction and then to identify retention of learning after a one-week delay.

Each newsletter was comprised of the same five tasks: (1) Create a banner heading using text boxes; (2) Insert and format text into columns with a banner heading; (3) Insert and format a graphic and apply word wrap; (4) Create and format a table; (5) Create a data source and mailing labels for a mail merge.

Each of the five tasks was timed for the pretest and posttests. For the pretest, subjects were allotted about 30 minutes—the amount of time it would take for an expert to complete the same tasks. For the immediate and delayed posttests, subjects were given a total of 45 minutes (divided proportionately among the five tasks) to complete all five tasks. Subjects were not timed during the completion of the treatment tasks, but were encouraged to move ahead without completing the tasks after a specified time (they had about 2 hours to complete the tasks).

Microsoft's *Camcorder* program was used to record in a movie format every keystroke and mouse movement on the screen. The movies for each subject were later burned to CD-ROM and then replayed and coded.

RESULTS

The two statistical analyses used in this research were a multiple multivariate analyses of covariance followed by analyses of variance, simple effects and pairwise comparisons for statistically significant findings. The multivariate analysis of covariance was selected in order to provide a benchmark comparison point when conducting a more complete and detailed description of differences among the groups, especially with correlated variable. The Bonferroni approach was used to prevent Type I error. Wilks lambda Λ was the statistic used to determine the multiple eta squared (η^2) effect size. Simple descriptive statistics were used to describe the sample population and their use of the online instruction.

A repeated measures analysis was conducted on an exploratory basis to provide a different perspective of the data by identifying any trends in learning over time.

Description of Sample Population

The majority of the sample population was comprised of females (88%) aged 18-25 (92%) with 1 to 10 years of computer experience (90%). Sixty-seven percent of the sample population indicated that they possessed an intermediate level of experience in Microsoft *Word* or Corel *WordPerfect*. Nearly 90% of the sample population was familiar with the IBM/*Windows* platform, and nearly 65% owned their own computer. The sample population used for this research was much more advanced in their use of computer technology than the sample population used by Carroll in his experiments in the early 1980s; however, the sample population more accurately represents the current target population.

Visual Illustration of Trend Results

Figure 2 illustrates an overall increase in the percent of tasks completed and the accuracy with which those tasks were completed. Figure 3 illustrates an overall decrease in the number of errors committed and the time it took to correct those errors. Also, although subjects corrected either the same or a smaller percentage of errors in the immediate posttest, they corrected a greater percentage of errors in the delayed posttest (a week later). However, Figures 2 and 3 also illustrate minimal differences among the three versions of online instruction.

Comparison of Online Instructional Systems

I measured instruction as "effective" in this research using the following variables:

1. Completeness: the ability to complete the given task
2. Accuracy: the exactness by which the subject's method for completing a given task matched the method outlined in the online help systems
3. Errors committed: the number of errors the subject made while completing a task
4. Percentage of errors corrected: the number of corrected errors divided by the total number of errors committed
5. Error recovery time: the total time spent correcting errors per experiment and activity.

Table 1 (see Author Note for url to tables) represents the combined output of the multivariate analyses of the five performance measures listed above applied to the skeletal, inferential, and elaborative versions of instruction for the treatment, posttest, and delayed posttest using the pretest measures as covariates. Only treatment was significant at the multivariate level ($\underline{F}=1.92$, $\underline{p} = 0.04$). An intermediate effect size ($\eta^2 = 0.09$) with a strong power ($1- \beta = .86$) indicated that the magnitude of the variance obtained was related to the treatment effects and the probability of obtaining such a difference by accident would be less than 15%. (Stevens [16] lists $\eta^2 = 0.01$ as a small, $\eta^2 = 0.06$ as a medium, and $\eta^2 = 0.14$ as a large effect size for social science research.)

Separate univariate analyses of covariances were conducted (Table 2) for each of the five measures to determine which measures contributed to the overall level of significance for the multivariate analysis of covariance during the treatment. Both the completeness and accuracy variables were significant at the .05 level of confidence ($\underline{F} = 3.37$, $\underline{p} = 0.04$; $\underline{F} = 3.36$, $\underline{p} = 0.04$, respectively). A medium effect size ($\eta^2 = .06$) and level of power ($1- \beta = .62$) were also obtained for both measures.

An additional pairwise comparison of the completeness measure revealed a statistically significant difference ($\underline{p} = .05$) between subjects in the elaborative and skeletal groups (Table 3). The mean completion scores (Table 4) for subjects using elaborative online help ($\underline{M} = .87$, $\underline{SD} = .14$) was statistically significantly greater at the .05 level of confidence than the completion scores for subjects using skeletal online help ($\underline{M} = .79$, $\underline{SD} = .18$). A standardized mean difference effect size (SMDES) of .49 indicated that subjects in the elaborative group completed about 7% more tasks (.49 x .14) than did subjects in the skeletal group.

Although not statistically significant, the standardized mean difference effect size (0.49) for the accuracy measures between the subjects in the inferential and skeletal groups tended toward significance ($\underline{p} = .0.07$), which contributed to the overall significance during treatment. This effect size indicates that subjects in the inferential group were 5% more accurate (0.49 x 0.11) in completing their tasks during the treatment than were their counterparts in the skeletal group.

SUMMARY AND CONCLUSIONS

The results from this research indicate that the principles of minimalism *can* be used to design effective online instruction and that variations in the instruction based on the designer's preference for more (elaborative) or less (inferential) instructional features will not significantly inhibit or increase the amount of learning.

The only significant differences among the three different versions of online instruction occurred during the treatment session, when the subjects had access to the instruction. Of the five measures (completeness, accuracy, errors committed, errors corrected, and error-recovery time), significance was obtained only on completeness and accuracy. The subjects using the elaborative and inferential versions of instruction completed more tasks than the subjects using the skeletal version. In addition, subjects using the elaborative and inferential versions of instruction were more accurate in their task completion than the subjects using the skeletal version.

Because each of these systems were designed to emphasize only the differences among the systems, it was interesting to identify *how* they were used in order to determine why there were minimal differences. Additional descriptive data gathered on the way the subjects used the online instruction revealed that although the elaborative version of instruction contained the most instructional features, subjects had to access the instruction more often to determine how to complete the tasks. It appeared from the video recordings of each subject's use of the instruction that the subjects tended to miss the critical instruction if the screen was filled with notes, hints, and other hypertext links. The subjects would have to return again to the same screen to find the step or steps they were missing. It was this type of instruction to which Carroll (5) objected.

Also of interest is the great disparity in use of instructional features between the inferential and skeletal version. The inferential system, with its omission of separate topics, required the users to interact more with the instruction and the software application interface in order to learn how to complete any given task. That interaction is, after all, the goal of instruction.

What does all this mean to us? Minimalism is an effective approach to designing online instruction. Furthermore, slight differences in the design of good instruction make little difference to a target audience with intermediate to advanced computer skills. The fact that subjects felt confident enough in their own ability to explore and learn from the interface without (as Carroll would say) letting the instruction get in the way of learning, lends support to the theory of minimalism. Subjects used the base of minimalist instruction in the different versions of online instruction and tended to ignore the different instructional components that varied among those versions. Instead, they interacted directly with the software to learn how to complete a given task.

We can use the findings from this research to determine how much and what types of instructional features to include or omit in our online instruction. It's a win-win situation. Identify what the end user wants and provide it: eliminate anything extraneous.

REFERENCES

1. Black, J. B., Carroll, J. M., & McGuigan, S. M. (1987). What kind of minimal instruction manual is the most effective? In H.J. Bullinger, B. Shackel & K. Kornwachs (Eds.), <u>Proceedings of the second IFIP conference on human-computer interaction</u> (pp. 159-162). Amsterdam: Elsevier.
2. Boggan, S., Farkas, D., & Welinske, J. (1996). <u>Developing online help for Windows 95</u>.

London: International Thomson Computer Press.

3. Brockman, J. R. (1990). Writing better computer user documentation: From paper to hypertext. New York: John Wiley.
4. Carlson, P. A. (1992). From document to knowledge base: Intelligent hypertext as minimalist instruction. The Journal of Computer Documentation, 16(1), 17-31.
5. Carroll, J. M. (1984). Minimalist training. Datamation, 30(18), 125-136, (1990), The Nurnberg funnel: Designing minimalist instruction for practical computer skill. Cambridge, MA: MIT Press.
6. Farkas, D. K. (1993). The role of balloon help. The Journal of Computer Documentation, 17(2), 3-19.
7. Gagne', R. M. (1985). The conditions of learning and theory of instruction. Chicago: Holt, Rinehart & Winston.
8. Greer, M. (1984). A trainer's guide to software documentation. Performance and Instruction Journal, 23(3), 6-7.
9. Hackos, J. T., & Stevens, D. M. (1997). Standards for online communication. NY: Wiley.
10. Hallgren, C. (1992). Nurnberg funnel: A minimal collection. The Journal of Computer Documentation, 16(1), 11-16.
11. Jansen, C. (1994). Research in technical communication in the Netherlands. Technical Communication, 41(2), 234-239.
12. Kearsley, G. (1985). Embedded training: The new look of computer-based instruction. Machine-Mediated Learning, 1(3), 279-296.
13. Lieberman, J. (1987). Implication of adult learning characteristics and learning styles for the design of software documentation. The Technical Writing Teacher, 14(2), 219-231.
14. Nowaczyk, R. H., & James, E. C. (1993). Applying minimal manual principles for documentation of graphical user interfaces. Journal of Technical Writing and Communication, 23(4), 379-388.
15. Rosenbaum, S. (1998). Follow-up on training in minimalism: How are technical communicators using minimalism? In J. M. Carroll (Ed.), Minimalism beyond the Nurnberg funnel (pp. 119-147). Cambridge, MA: MIT Press.
16. Stevens, J. (1996). Applied multivariate statistics for the social sciences (3rd ed.). Mahwah, NJ: Erlbaum.
17. Techwriters. (1997). Minimalism/minimalist discussion. Cambridge Publications [On-line]. Available: http://www.raycomm.com/techwhirl/archives.html
18. van der Meij, H., & Carroll, J. M. (1995). Principles and heuristics for designing minimalist instruction. Technical Communication, 42(2), 243-261, (1998). Principles and heuristics for designing minimalist instruction. In J. M. Carroll (Ed.), Minimalism beyond the Nurnberg funnel (pp. 19-53). Cambridge, MA: MIT Press
19. van der Meij, H. & Gellevij, M. (1998). Screen captures in software documentation. Technical Communication, 45(4), 529-543.

Author Note: The full version of this article (including supporting figures and tables) can be located in both .html and .pdf file format at http://www.pcu.net/web/prattbj/iis/instfeat.htm

Funding for this research was provided by the Society for Technical Communication, Utah State University Women & Gender Institute, and Delta Pi Epsilon.