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Controlling the slides: Does clicking help adults learn?

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ABSTRACT

When utilizing screen media as an educational platform, maintaining control over one's experience may lead to more successful learning outcomes. In the current work, adults learned four new action sequences, each via a different slideshow type. The computer advanced slides automatically, but each version had a different pausing mechanism: (1) free pause (viewers could click the mouse at any point to pause the show), (2) subgoal pause (show paused after subgoals, viewer clicked to continue), (3) timed pause (show paused every 20 slides, viewer clicked to continue), and (4) no pause (no viewer interaction). Participants completed a written memory test, live performance test, cognitive load measures, and satisfaction measures. Results indicated that memory recall was significantly lower in the no pause version when compared to the versions with pause capability. Also, over half of participants reported that the no pause version was their least favorite format to learn from. Conversely, over half of participants selected the free pause as their favorite slideshow format, and participants reported that they felt most in control of the free pause version. These reports occurred in spite of only one-quarter of all participants actually using the click-to-pause feature in the free pause slideshow. Perhaps the mindset of being in control, rather than the pausing itself, increased likeability of the program. This research has implications for program design and education, pointing to flexible pacing features being helpful in enhancing users' enjoyment of the program and ability to extract novel information.

1. Introduction

In recent years, the use of technology for learning purposes has skyrocketed. From MOOCs (massive open online courses) to smartphones, there has been an influx of new technology that offers potential for learning. Students are completing degrees online, teachers are adapting coursework to appear in electronic formats, and job hunters are often seeking telecommuting positions. The rapid increase of information technology has spurred research regarding the usefulness of the screen in complementing and enhancing learning outcomes. Given the flexibility that screen learning can provide (such as working from home or on the go), there is a need for more research on digital platforms and their role in the learning process. A key question surrounds what *type* of learning platform is best. What electronic features encourage, or inhibit, the learning process?

Research into online environments has consistently shown that interactivity leads to better learning outcomes. Zhang, Zhou, Briggs, and Nunamaker (2006) compared college students' learning about Internet search engines under four different conditions: traditional classroom, e-learning with interactive video, e-learning with non-interactive video, or e-learning with no video. The interactive video, which allowed users to proactively engage in the content and view clips at their own pace, resulted in the best learning outcomes. Furthermore, students were more satisfied when utilizing the interactive e-learning platform when compared to the other media. The researchers speculated that controlling one's pace through the learning process provided a more personalized learning experience for students.

There are many reasons why learning from a computer may be most successful with an interactive component. Navigating oneself might be advantageous, and this ability to choose one's trajectory through the learning process might enhance intrinsic motivation (Becker & Dwyer, 1994; Berge, 2002; Domagk, Schwartz, & Plass, 2010; Zhang, 2005). Interactive technology can make the experience more learner-centered. Learners in control can discover for themselves how to learn; they make their own decisions regarding the material (Merrill, 1975). To illustrate, Wang and Reeves (2007) looked at how an interactive web-based platform affected students' motivation in an earth science course. Students reported enjoying the web-based learning environment. Classroom observations showed that students

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maintained focus on the e-learning activity and displayed enhanced curiosity by viewing non-mandatory portions of the program. By giving students a sense of self-responsibility over the assignment, motivation to learn was enhanced.

One way in which interactivity can be effectively incorporated into programs is by breaking information down into segments. For instance, individuals often turn to YouTube videos to learn a particular skill (Jaffar, 2012; Lee & Lehto, 2013). YouTube videos have a pausing function and allow the viewer to fast forward and rewind as needed. Schaffer and Hannafin (1986) utilized segmented videos and continuous videos with adults, reporting that the segmented video took students longer to view but resulted in better learning outcomes. One potential explanation is that students had more time to think through the information presented when given the segmented version, thus leading to a deeper level of information encoding.

Videos are a common medium to investigate within the realm of e-learning. However, an alternative, but similar, medium that can also incorporate aspects of pausing and self-control are slideshows. Slideshows have built-in pauses after each slide and can be controlled in a variety of ways. Interestingly, results have been conflicting regarding how much control is optimal when learning from slideshows (Lawless & Brown, 1997; Scheiter & Gerjets, 2007). Some findings show that slideshows might increase engagement in digital environments. To illustrate, Mayer and Chandler (2001) used slideshows to teach college students about lightning formation. Students were given the option to advance through the presentation twice in parts via clicking a mouse, or were allowed to click through the parts and then watch a continuous animation. Those participants with more control were more successful on a knowledge task than their peers who watched continuous animations or viewed a continuous animation before breaking it down into parts. Viewing the slides in this piecemeal format either on their own or prior to launching into a continuous animation likely allowed learners to break down the information in a more effective manner, and thus organize and apply the information with higher success.

Other work by Sage and Baldwin (2014) found that students learned from a yoked-paced slideshow better than from a self-paced slideshow. In their research, half of participants (self-paced) clicked a mouse to advance through images of a novel action sequence that they were tasked with learning. The other half of the participants (yoked-paced) watched the slides automatically advance by the computer at another person's pace (e.g., the first participant in the yoked version saw the slides automatically advance at the pace that participant one had set in the self-paced version). One potential explanation for why self-control in these self-paced slideshows was not valuable is the burden placed on the user. These slideshows included over 500 slides; attention was likely divided between the mouse in-hand and the images on the screen. Given the extensive clicking, participants may have become frustrated and thus distracted from the task. Such usability issues with technology have been postulated to detract from the learning process (Scheiter & Gerjets, 2007).

In an illustration of these mixed findings, Hoffler and Schwartz (2011) investigated the impact of representation type on the benefit of self-pacing. They showed either static pictures or animations to students, and varied whether the show was self-paced by the user or system-paced. Though no main effect of pacing or image type was observed, there was a notable interaction. When presented with animations, learners were more successful when self-pacing. When presented with static images, learners were more successful with system-pacing. This finding suggests that benefits of self-pacing might vary based on the content of the program. When looking at the other research, the lightning formation stimuli in Mayer and Chandler (2001) seemed more reminiscent of an animation while Sage and Baldwin's (2014) work extracted frames from a video, akin to static images. This difference in stimuli is one potential explanation for the mixed findings.

In a recent follow-up study, Sage (2014) investigated how learning outcomes from the yoked-paced slideshow compared to a more predictably paced slideshow and a video. It is possible that the users in Sage and Baldwin (2014) did better under computer control because the program advanced at a realistic pace – i.e., the pace that a real user would go through those slides. Sage investigated four slideshow types: self-paced (user clicked mouse to advance), yoked-paced (program advanced slides at a pace matched to a prior self-paced user), set-paced (program advanced slides every 750 ms), and continuous video. Similar to the prior work, participants recalled more target actions from the computer-controlled slideshows than the self-controlled slideshow. In terms of their ability to perform the actions, the set-paced group produced the most successful performers while the self-paced group produced the poorest performers. Learning from a continuous video tended to fall in the middle of learning outcomes, with yoked-paced slideshow users performing between the video and set-paced slideshow users.

This work begs the question of why the set-paced version, which involved no learner control, produced the best learning outcomes. It seems intuitive that participants learned more from the set-paced slideshow than the video, given that the set-paced slideshow broke up the information to some extent. However, a learner might also want to be in control of their learning process. Still, this study had the same usability issue as Sage and Baldwin (2014). The user had to click many times (500+) to advance through all slides, thus providing an explanation for why the self-paced users met with poor learning outcomes. Additionally, as Hoffler and Schwartz (2011) mentioned, information from static images might be best learned from a system-controlled program. The predictable timing of the set-paced version was perhaps helpful in organizing the information and in knowing how long one had to encode the information on the slide (i.e., no surprises in how quickly or slowly the slide advanced). This past work thus seems to suggest that self-control is not always a helpful design option for a program, but that reliable segments might ease the cognitive burden of learning new information. A remaining question is if and how some user control can be combined with this reliable pace to produce a superior learning medium. Given that other work has implicated the benefits of interactivity and user control (e.g., Mayer & Chandler, 2001; Wang & Reeves, 2007), combining a reliable pace with user control might be a logical next step.

Furthermore, one must consider that these electronic learning programs can be designed with a variety of types of control over the process. As described by Hannafin (1984), programs can lead learners through a particular path of information while, if given self-control, learners can determine a different individualized path and pace of learning, possibly different from the path intended by the programmer. A blend of system- and user-control might involve some room for freedom via pausing and selecting for oneself, while still following the general intended path through the program. The set-paced version of Sage (2014) was entirely program-controlled and automatically determined the path for the learner. The yoked-paced and video versions in her work were also entirely controlled by the computer. Though the self-paced version was a blend where the program determined the path while the user determined the pace, it seems likely that this blend of control was not optimal given the large number of slides utilized and thus corresponding high cognitive load of the task. A different combination of learner and computer control might help improve learning outcomes for students.