THE MATCH GAME: PUTTING SOFTWARE AND LEARNERS TOGETHER

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> Learning is a relatively permanent change in performance that can be shown to be the result of experience (Fitts & Posner, 1967, p. 8).

The main goal of educational technology is to assist the learner in making sense of the world in the most effective, efficient manner. Therefore, putting learners and technology together is a matter of determining the needs of the learner and matching those needs with proper technological tools. Moreover, it is important to match the software available within specific disciplines to strategically develop the skill sets required for proficiency in that domain. Research in cognitive psychology has begun to uncover the frameworks underlying particular performance requisites in various domains (Anderson, 1987). These researchers realize that "understanding and substantiating the details of how knowledge is acquired in their framework is a prerequisite to advancing their grander claims about the nature of cognition" (p. 193). Once the skill sets are understood, practice appears to play a large role in the development of expertise (Williamon & Valentine, 2000). This paper will address the implications of "deliberate practice" as it relates to choosing software for the development of specific skills within any field.

Researchers have examined salient characteristics of exceptional performances in a number of domains to provide evidence for how specialized skills are acquired. A few examples of studies in outstanding performances include the areas of chess (Chase & Simon, 1973a, 1973b), mental calculation (Staszewski, 1988), basketball (Allard, Graham & Paarsalu, 1980), and figure skating (Deakin, 1987). The conclusions drawn from these studies suggest that outstanding performances are not necessarily due to exceptional ability or to divine intervention, but to extensive training over time.

The Power Law of Practice, a cognitive psychology term, has been used to describe this phenomenon. This law states "the speed of performance of a sensorimotor task increases as a power function of the number of times the task is performed" (Williamon & Valentine, 2000, p. 354). Other researchers suggest that this law applies to purely cognitive learning situations as well (Anderson, 1982). Anderson observed that approximately 100 hours of learning and practice were required to acquire a 'reasonable degree of proficiency' (p. 369). Music researchers (Sloboda, Davidson, Howe, & Moore, 1996) found that approximately 3300 hours were necessary over a period of approximately 10 years for young musicians to become proficient enough on the piano to reach principal instrument level in a university program. Those pianists who reached expert level by age 20 estimated a total of 10,000 hours of practice by the start of their performance careers (Ericsson, Krampe, & Tesch-Römer, 1993).

There are three stages of skill acquisition proposed by Fitts and Posner in "Human Performance" (1967): the cognitive, associative, and autonomous stages. The cognitive stage involves the use of cues, demonstrations, and recall of events

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that trigger old patterns. The associative stage of learning involves the integration of practice with the new patterns to gradually eliminate errors. Practice needs to be sequenced for each skill component, scheduled appropriately with frequent repetition within short periods of time, and alternated between part and whole practice—if components must work in tandem—to successfully perform the task. The autonomous stage of learning is characterized by the need for less cognitive control and less processing of each detail. Several strategies have emerged from these studies for achieving greater autonomy, thereby lowering cognitive overload (chunking, proceduralization, compression, and induction). Please refer to Fitts and Posner (1967) for a more detailed description of these strategies.

This learning process was the basis of a recent pilot study for the current dissertation project. Sight reading, or more specifically sight playing, at the piano requires real time processing of new information. Sight playing is defined as playing a novel piece of music without prior preparation. After the piece is played once, playing it again technically becomes practice or rehearsal rather than sight playing. By studying the research base for piano sight playing, the skills needed to acquire expertise were defined and software was found that would develop these skills most efficiently, matching the age level of the subjects. Six subjects from a third year group piano class for music majors whose major instrument was other than piano participated in a case study. Six lessons were designed which were linked to specific skills using a piece of software. The realization that expertise is gained over a significant amount of time was taken into account, looking for minimal gains. Also a factor in working with software is learning style and individual differences. Therefore, subjects were given the Group Embedded Figures Test (GEFT) devised by Witkin and others to discover one's level of field dependence (global) versus field independence (articulated) on a continuum of extremes of each (Witkin, Oltman, Raskin, & Karp, 1971). Field dependent (FD) learners have a more difficult time taking apart the visual field and tend to process information in larger chunks as presented. Field independent (FI) learners are able to dissect the visual field and reconstruct the information to meet their own learning needs. It was hypothesized that using an accompanying method of improving sight playing would better suit the field independent learners, as more emphasis is placed on timed performance, requiring faster processing and the ability to structure the visual field (in this case a piano score) to match their skills. Subjects were pretested before beginning the treatment program.

One of the most important skills in sight playing is performing musically, while at the same time processing the notes on the page for the first time. Two specific skills necessary to achieve this are keeping the eyes moving forward in a continuous fashion, reading slightly ahead of the hands, and keeping a steady beat, leaving notes out if necessary. The software used to develop these skills was Finale© by Coda, a notation program designed to print sheet music. Subjects were presented with new music each session. They were to spend time mentally previewing the piece without any physical practice before playing the music. They then started the playback function on the computer and played a duet with the computer. The goal was to stay with the computer and to play as many correct

notes as possible. The eye tracking device was an integral feature of the program, which kept their eyes moving forward, avoiding the typical problem of getting "stuck" at a trouble spot. After six sessions subjects were given a posttest, which was scored by two independent judges.

There was no significant difference between the pretest scores and posttest scores ($p > .05$), as was anticipated. Subjects were then divided into two groups for further comparison (FD = 3; FI = 3). Results indicated that no significant differences ($p > .05$) existed at the time of the pretest. FI subjects achieved significantly higher scores ($p < .05$) after the six sessions than did the FD subjects. This result allowed for the decision to accept the hypothesis that the treatment met the needs of FI students more effectively than for the FD subjects. While it is important to consider these results with caution, the results warrant further investigation.

Several questions should be addressed when matching software to learners for the purpose of skill acquisition. Among them are:

- At what stage of learning are the students in question?
- What skills do the learners need to develop?
- What skills will the software develop?
- What kind of learner will be best served by the presentation style of the software?

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