

Chapter XIV

Teaching Java™:

Managing Instructional Tactics to Optimize Student Learning

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ABSTRACT

Information systems students in a graduate section and an undergraduate section of an introductory Java graphical user interface course completed the following initial assignments to learn a simple program: (1) automated programmed instruction tutoring, (2) hands-on learning with a lecture, and (3) collaborative peer tutoring. Tests of knowledge transfer and software self-efficacy were administered before students began the first assignment and following completion of each one. The results showed progressive improvement in rule test performance and software self-efficacy across the several instructional events. Taken together, the results of these classroom observations extend the generality of previous work to an updated set of instructional materials and assignments, and that outcome shows the reliability of the learning processes with new groups of students. Students who are new to Java had the privilege of exposure to an initial repertoire of teaching tactics that are synergistic and cumulative.

INTRODUCTION

The research reported here is part of an ongoing stream of formative evaluations of instructional tactics that are intended to help novice, college-level students acquire skill and confidence in

computer programming by means of an integrative approach to curriculum development (Emurian, in press: a). Direct mastery of the core knowledge in a discipline is recognized as a fundamental requirement to apply and extend that knowledge to solve novel problems, and that implies consid-

eration of an instructional design to overcome the empirically verified shortcomings of teaching tactics that provide minimal guidance during a student's learning experiences (Kirschner, Sweller, & Clark, 2006). The integrative tactics adopted in our classrooms are in furtherance of helping all of our students to succeed.

Our previous work consistently confirmed the value of programmed instruction in teaching introductory information systems students a simple Java applet as a first technical training exercise in preparation for advanced learning (Emurian, 2004, 2005, 2006a,b). A Web-based, programmed instruction tutoring system to accomplish that objective was presented in Emurian, Hu, Wang et al., (2000), and behavior principles supporting the design and implementation of the system were described by Emurian, Wang, and Durham (2003) and Emurian and Durham (2003). Similar value of programmed instruction is evident in its applications within other symbol intensive disciplines, such as chemistry (Kurbanoglu, Taskesenligil, & Sozbilir, 2006), and its training effectiveness in fostering parent-teacher communications has been demonstrated (Ingvarsson & Hanley, 2006). The objectives of our work are to apply programmed instruction and to assess its effectiveness as a tactic to promote a common level of mastery by all students for a designated learning objective in Java programming. An optimal outcome of such a direct mastery approach is taken to reflect a *true gain* in learning (Anderson, Corbett, Koedinger et al., 1995).

Among several recommendations for effective learning principles to foster retention and transfer of knowledge is repeated practice with different instructional modalities (Halpern & Hakel, 2003) and with socially supported interactions (Fox & Hackerman, 2003). The modalities that have been adopted in our most recent classroom applications include: (1) programmed instruction, (2) lectures with hands-on learning, and (3) collaborative peer tutoring (Emurian, 2006b; in press:b). These tactics are demonstrably effective in promoting

programming skill, software self-efficacy, and generalizable knowledge, the latter reflecting *far transfer* of learning (Barnett & Ceci, 2002). The benefits on student learning of a somewhat different, "blended" instructional approach to teaching introductory Java have been reported by Boyle, Bradley, Chalk et al. (2003), where repetition of similar topics occurred throughout the course syllabus. Our assessments of student learning, however, sometimes showed room for improvement in the goal of achieving maximal performance by all students on a far transfer test that was administered immediately following collaborative peer tutoring (Emurian, 2006b; in press:b).

To potentiate the effectiveness of the collaborative peer tutoring, the present classroom studies undertook a modification to the instructions and materials that made available to students to prepare them for collaborative peer tutoring and to use during the collaboration session. The modified procedure allowed the collaborating students to view and discuss together the questions that constituted the test of far transfer. Collaborating students also had direct hypertext access to instructional frames that were otherwise presented sequentially and contingently within the Java programmed instruction tutoring system. Finally, the Java program to be learned by students, as the first technical exercise in a course, contained more items of code to be mastered in comparison to the previous work in this area of classroom applications and research.

METHOD

Subjects

Subjects were as follows: (1) 13 graduate students, four females and nine males, taking IS 613 (*GUI Systems Using Java*) during a four-week summer session (summer 2006), and (2) 14 upper-level undergraduate students, six females and eight

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