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December 1999

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James Coakley
Oregon State University

Craig Tyran
Oregon State University

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Recommended Citation

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<http://aisel.aisnet.org/amcis1999/334>

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Computer skills and student learning: The impact of feedback and on-line learning resources on student learning performance

James R. Coakley and Craig K. Tyran
Department of Accounting, Finance, and Information Management
College of Business
200 Bexell Hall
Oregon State University
Corvallis, OR 97331-2603
coakley@bus.orst.edu tyran@bus.orst.edu

1. Abstract

There is much interest in applying WWW and Internet technology to learning. This study addresses one important aspect of the web-based learning process: feedback. The way in which feedback is provided to a learner has been found to have a strong impact on learning performance (e.g., Bangert-Downs, et al., 1991). The primary research question in this study is “What impact will an automated feedback mechanism have on learning performance of computer skills?” Based on a review of the literature and theory, it is hypothesized that the feedback mechanism developed for this study will significantly improve learning performance. A longitudinal field experiment is presently being conducted to answer the research question. Research data is being collected from over three hundred students taking an introductory computer skills course. The learning tasks for the study will include a series of microcomputer skill assignments involving such skills as file management, word processing, and spreadsheet development. An automated feedback tool will provide feedback to students. The tool will use a computer program to evaluate student work and prepare a customized report to the student describing the aspects of each student’s work that were not performed correctly.

2. Introduction

As suggested by Gagne’s theory of learning, one of the most important factors contributing to learning is feedback (Gagne, 1977). Feedback provides reinforcement of a job well done or provides information about how to improve. The way in which feedback is provided to a learner has been found to have a strong impact on learning performance (e.g., Bangert-Downs, et al., 1991). Finding a means of providing effective feedback to learners is thus an important goal of developers of web-based systems for learning. As there can be operational difficulties in providing timely and

comprehensive feedback to distributed learners, it is also important to find a feedback mechanism that will help to automate the feedback process for web-based learning.

The primary research question in this study is “What impact will an automated feedback mechanism have on learning performance of computer skills?” Based on a review of the literature and theory, it is hypothesized that the feedback mechanism developed for this study will significantly improve learning performance. It is expected that the findings from this study will help to refine the theory of learning and feedback, as well as instructional practice.

3. Literature review

The impact of feedback on learning has been explored in a variety of research conditions and settings. Reviews of the literature show that past studies have found that the effect of feedback on learning performance has produced counterintuitive results: sometimes the effect is positive and other times it is negative (e.g., Kulik and Kulik, 1988; Kulhavy, 1977). It is clear that providing feedback to learners will not always guarantee an improvement in learning performance. To help explain the variation in research findings, researchers have identified key mediating factors that appear to influence the effects of feedback. It appears that feedback is most effective in cases when pre-search availability is controlled (i.e., learners can not “peek ahead” to find the correct answer), when the feedback provides guidance on finding the correct answer (as opposed to simply providing a right/wrong form of feedback), and when feedback is used in conjunction with a testing or text comprehension type of instructional approach (Bangert-Downs, et al., 1991).

4. Research method

A primary objective of this research study is to evaluate the impact of an automated feedback mechanism on student learning with respect to learning tasks involving computer skills. A longitudinal field experiment is presently being conducted to address the research question. Following is a brief discussion of the research subjects, tasks, treatment and measures.

Subjects: The subjects for the study are college students enrolled in an introductory microcomputer skills course. Typically, the students taking this course are traditional first-year college students. Approximately two hundred students enroll in the class each term, with approximately one hundred and sixty students successfully completing the course each term. Students taking the course during the Winter 1999 and Spring 1999 quarters will be involved in the study.

Tasks: The tasks will include a series of microcomputer skill assignments involving such skills as file management, word processing, and spreadsheet development. Each task is a self-contained assignment that requires students to apply a variety of computer skills. For example, a task involving spreadsheet skills requires students to enter formulas, use functions, and create graphical charts of numerical data. The tasks will be similar, but not exact, for each term. That is, the concepts and skills required to complete each assignment will be identical, but the data used within the assignment will be altered from term to term (e.g., for spreadsheet tasks, a different set of spreadsheet data will be used in each assignment).

Automated feedback tool: An automated feedback tool has been developed that will provide feedback to students. The tool will use a computer program to evaluate student work and prepare a customized report to the student describing the aspects of each student's work that were not performed correctly. The tool has been developed using the "Visual Basic for Applications" programming language that is supported by Microsoft Office software products. A separate evaluation/feedback program has been developed for each of the assignments. The program will be run when a student submits their assignment via electronic mail. After the program is run, feedback will be provided immediately to the student via electronic mail.

Experimental Treatment: The independent variable that will be manipulated for this study is the type of feedback provided on homework assignments. There will be two treatment groups. The content and format of feedback received in each treatment group will be the same. The difference in the treatments will be that one

group will have the opportunity for an extra feedback loop to be provided by the automated feedback tool.

The dependent variable for the study will be learning performance. This variable will be measured by a student's performance on proficiency exams. Statistical comparisons will be made to test the research question concerning the impact of feedback on learning performance. To help assess pretreatment and post treatment differences between experimental groups, comprehensive pre and post-course surveys will be administered to assess the student's perceptions of their computer skills. Statistical comparisons of students in the different treatment groups will be conducted. When interpreting the findings of the study it will be useful to have a record of how students prepared for the assignments and exams. To help monitor student learning behaviors, all individual student activity on the course WWW site will be logged and captured. The WWW logs will provide a very rich set of research data that may be used to partition and interpret the research findings. Statistical analysis (regression, factor analysis, multiple discriminate analysis) will be used to analyze the relationships among the students' pre and post-course surveys, usage of course resources, and actual performance on assignments and competencies exams. Pre-planning and data collection for the study has been initiated and will continue through June 1999.

Measures and Data Analysis: The dependent variable for the study will be learning performance. This variable will be measured by a student's performance on proficiency exams. Two exams will be administered. One exam will assess the skills taught in the first half of the course and the second exam will cover the skills taught in the second portion of the course. Each exam will measure each student's proficiency with respect to a variety of computer skills. As each proficiency exam will be subdivided into sections addressing different computer skills, it will be possible to determine a student's performance level for different skills, resulting in different outcome measures for different types of skills. A student's performance on different portions of the exam can thus be related to individual assignments. Statistical comparisons will be made to test the research question concerning the impact of feedback on learning performance.

In addition to the outcome measures, a number of other types of data will be collected. Given that it is difficult to control all experimental conditions for a field experiment, it will be important to collect data to assess whether there may be differences in the subjects in the different treatment groups. To help assess pretreatment and post treatment differences between experimental groups, comprehensive pre and post-course surveys will be administered to assess the student's perceptions of

their computer skills. Statistical comparisons of students in the different treatment groups will be conducted.

It is possible that different students will use different learning strategies to learn the course material. When interpreting the findings of the study it will be useful to have a record of how students prepared for the assignments and exams. While it will not be possible to monitor all of a student's learning activity outside of the classroom, we have designed a way to track student learning activity in one major area -- the course WWW site, which serves as the primary source for all course materials. For example, materials at this site include descriptive tutorials, video-clip files demonstrating specific computer skills, practice assignments and the actual assignments. To help monitor student learning behaviors, all individual student activity on the course WWW site will be logged and captured. The WWW logs will provide a very rich set of research data that may be used to partition and interpret the research findings. Statistical analysis (regression, factor analysis, multiple discriminate analysis) will be used to analyze the relationships among the students' pre and post-course surveys, usage of course resources, and actual performance on assignments and competencies exams.

5. Research Contributions

This study draws on past research by developing a feedback approach for a computer skills class that is consistent with the most favorable type of feedback conditions described above. The study will extend the past research in several ways. First, the study will involve the use of a multi-feedback approach that has not been previously studied. Second, the study will be longitudinal in nature and will expose students to the feedback approach over longer period of time than the typical feedback research study. Third, the study will demonstrate the use of new type of automated feedback delivery mechanism. Fourth, the study will involve the collection of a rich data set of information that will help improve our understanding of computer-supported learning environments. Fifth, the study will address computer skills learning tasks that are important to business and information systems education

6. References

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