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ABSTRACT

This paper presents a model of how multimethod approaches to research can be used to understand and measure individual diversity in learning, cognitions, and affect. The paper demonstrates the value of gathering qualitative data to supplement quantitative findings from quasi-experimental research in relation to achievement outcomes, acquiring a metacognitive strategy of self-questioning, self-efficacy, and anxiety. An aptitude-treatment study was conducted to investigate the comparative effects of two instructional approaches on achievement, metacognitive strategy acquisition, self-efficacy, and anxiety in a semester-long computer training program. There were 22 college students in the intervention group and 23 in the comparison group. Simultaneously, continuous qualitative data collection and analyses were conducted. Eight case studies were selected for the qualitative study. Results indicate complex relationships between initial levels of self-efficacy, anxiety, and instructional treatment. The simultaneously conducted qualitative studies enabled researchers to situate these effects in a holistic context. (Contains 27 references.) (Author/SLD)

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**Metacognitive strategy training in self-questioning: The strengths of multimethod investigations of the comparative effects of two instructional approaches on self-efficacy and achievement.<sup>1</sup>**

**Paper presented at the American Educational Research Association  
San Diego, April 13-17 1998**

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### **Overview**

This paper presents a model of how multimethod approaches to research can be used to understand and measure individual diversity in learning, cognitions and affect. The paper demonstrates the value of gathering qualitative data to supplement quantitative findings from quasi-experimental research in relation to achievement outcomes, acquiring a metacognitive strategy of self-questioning, self-efficacy, and anxiety. Specifically, an aptitude-treatment-interaction study was conducted to investigate the comparative effects of two instructional approaches on achievement, metacognitive strategy acquisition, self-efficacy and anxiety in a semester-long computer training program. Simultaneously, continuous qualitative data collection and analyses were conducted.

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<sup>1</sup> Full text of intervention study reported in McInerney, V., McInerney, D. M., & Marsh, H. W. (1997). Effects of metacognitive strategy training within a cooperative group learning context on computer achievement and anxiety: An aptitude-treatment interaction study. *Journal of Educational Psychology*, 89, 4, 686-695.

The specific objectives of the research were to:

- 1) Compare the achievement, self-efficacy, motivation and anxiety of a sample of students undertaking a computing course taught through one of two methods: Direct instruction alone or a combination of direct instruction and cooperative, self-regulated learning which incorporated training in the metacognitive strategy of self-questioning.
- 2) Describe and evaluate each instructional program in operation using qualitative research techniques, namely, regular in-depth interviews with a selection of case study students who had both high and low anxiety and self-efficacy with regard to computing, analyses of case study logbooks and instructor tutorial diary, and molecular analyses of survey data collected at pre- and posttest.
- 3) Correlate data from case studies regarding their perceptions of the computer skills training they received in the context of gaining self-efficacy and self-regulated learning skills, as well as of their experiences of anxiety alleviation or exacerbation.
- 4) Triangulate the data obtained through quantitative research methods from the full groups involved in the quasi-experimental research with those from the qualitative data collected from the case studies.

## **Method**

### **Quantitative Study**

The comparison group received a direct instruction (teacher-led) approach (Rosenshine, 1986; Rosenshine & Meister, 1995) which has been traditionally used for skills training such as in computing. Proponents of this approach maintain that by proceeding in systematic short steps and giving guided practice, students' working memory is less overloaded, thereby alleviating anxiety (Tobias, 1986). The intervention group received an approach which built on direct instruction by adding cooperative self-regulated group work (Johnson & Johnson, 1991; Kagan, 1994; Schunk, 1990; Zimmerman, 1990; Zimmerman, Bonner & Kovach, 1996) in which students were trained in the process of self-questioning following the approach of Alison King (King, 1991a & b, 1992, 1993, 1994; see also Rosenshine, Meister, & Chapman, 1996). Self-questioning was predicted to reduce anxiety and enhance perceptions of control in computing situations, thus increasing self-efficacy (Bandura, 1988, 1993).

An aptitude-treatment-interaction (ATI) design was utilized in the quasi-experimental study as it allows for complex analyses of the effects of instructional methods (Cronbach & Snow, 1977; Borg & Gall, 1989; Borg, Gall, & Gall, 1993). The ATI study focused on the interaction between the two different instructional approaches and the different levels of learners' self-efficacy, positive and negative cognitions, anxiety and prior computing competence.

### **Qualitative Study**

The qualitative approaches used in the studies reported are based on the work of Bouma (1996), Cohen & Manion (1994), Miles and Huberman (1994), and Wiersma (1991). Among the techniques used were: semi-structured, in-depth interviews with case study students held after each tutorial over the semester-long computer course; case study logbooks kept throughout the course of their training; molecular analyses (Peck & Hughes, 1996) of case study survey data; and the instructor's tutorial diary in which detailed records of weekly tutorials were kept.

### **Participants**

Quantitative Study. Two groups of students completing compulsory computer coursework in the subject Introduction to Computers were randomly assigned to the two instructional approaches taught by the same instructor. There were 22 students in the intervention (metacognitive training within a cooperative learning context) group and 23 in the comparison (direct instruction) group. The average age of the students was 20 years.

Qualitative Study. Eight case studies were selected for the qualitative study from the two groups on the following basis: The two students (one male and one female) in each of these groups with the highest and the lowest anxiety and positive cognitions scores on the Computer Anxiety and Learning Measure were invited to participate in the research.

### **Measures**

The Computer Competency Checklist (Lawson & McInerney, 1994) was used to determine the levels of perceived student self-efficacy with regard to specific computing skills to be covered in the course (DOS, word-processing, database, and spreadsheet). The Computer Anxiety and Learning Measure - CALM (McInerney, McInerney, & Roche, 1994) was used to determine levels of positive and negative cognitions, and computer anxiety.

## Results

Significant ATI effects indicated complex relationships between initial levels of self-efficacy, anxiety and instructional treatment. The simultaneously conducted qualitative studies enabled the researchers to situate these effects (which were based on measures of central tendency) in a holistic context where individual parameters of the interactions were the focus of attention. Apparent anomalies in the quantitative findings were explicated through the molecular examination of individual scores, detailed analyses of the case study interview transcripts and tutorial logbooks, and instructor's tutorial diary.

Quantitative findings. Those with initially low self-efficacy at the start of the course increased their level of positive cognitions in relation to computing (perceptions of control and a computing self-concept were enhanced) after receiving the intervention; those with high initial self-efficacy were advantaged by being in the direct instruction group. Students receiving both instructional approaches achieved equally well at the end of the course on a range of assessment measures. High anxious students receiving the intervention reported less anxiety at the end of their computer training course than those in the comparison group except in relation to receiving feedback on competency and fear of public embarrassment when using computers. The results of this study are reported in detail in McInerney, McInerney & Marsh, 1997.

Qualitative findings. In trying to understand “What is going on here?” (Bouma, 1996, p.169) from the perspective of the case studies and the instructor, the following emerged from the qualitative data and analyses.

### Metacognitive Strategy Training

- Metacognitive training in self-questioning enhances self-regulation and learning.
- Reciprocal questioning develops self-questioning skills and builds positive cognitions.
- Training in self-questioning develops content knowledge, self-efficacy and self-regulated learning skills.
- Mutual “helping” relieves anxiety and builds confidence.
- Anxious students can avoid embarrassment through reciprocal peer questioning.
- Positive cognitions can develop even when anxiety is reported.

### **Cooperative Self-Regulated Groupwork**

- Groupwork helps learning, enhances motivation, builds confidence, and dissipates anxiety.
- Growing self-efficacy comes from structured groupwork and training in the use of generic question stems.
- Students develop skills in problem-solving
- Students are more active and involved with cooperative groupwork.
- Instructor's role is one of facilitator.

### **Direct Instruction**

- Sense of control over learning is absent in teacher-led instruction.
- Sense of self-efficacy varies considerably according to the tutorial content
- Reception learning is boring and unmotivating.
- Anxiety is related to dependence on the instructor in direct instruction.
- Spontaneous groupwork emerges even within teacher-led instruction.
- Attendance problems in direct instruction groups are related to lack of student motivation and commitment.
- Instructor's role is one of expert trainer.

## **Conclusion**

Results from the multimethod research techniques used in the present studies provide strong support for the educational value of including metacognitive strategy training in self-questioning within a cooperative learning context into traditional methods of teaching computing skills to those learners who lack confidence and perceptions of control in computing situations, or who fear public embarrassment while learning. Learning outcomes in terms of both personal (self-concept, self-efficacy and self-regulation) and achievement gains are strongly predicted with such an instructional approach. These research findings have considerable implications for the design of instruction in general, and for computer training programs in particular.

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