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Teaching and Measuring Higher-Order Thinking

1. The Teaching Innovation

While there are many views of improving education, one vision of education innovation is to change the modes of thinking of students. Higher-order thinking is a thinking process more than simple memorization and comprehension, and involves a variety of cognitive processes, such as summarization, identifying general principles, exploring various situations, reconciling options, monitoring progress, and so on. The course for this project of OFD Innovation in Teaching is MIS 212 Programming and Problem Solving. It is designed for sophomore students in the major of management information systems (MIS) to learn computer programming languages for business problem solving. The teaching innovation practice in this course has established the following unique teaching practices.

- (1) To teach the computer programming course in the context of teaching higher-order thinking.
- (2) To identify pertinent higher-order thinking skills as a major part of learning outcomes of this course.
- (3) To develop measures of higher-order thinking, and to apply them to assess the learning outcomes of this course.

This project of OFD Innovation in Teaching places a focal point on higher-order thinking outcomes beyond computer programming fundamentals, as specified below.

- (1) *Problem solving skills* – The thinking ability of matching business problems and computer tools.
- (2) *Self-regulation skills* – The thinking ability of self-monitoring and learning from mistakes.
- (3) *Creativity skills* – The thinking ability of being effortful and creative.

2. Positive Results of the Innovation on Student Learning

Positive results of the innovation on student learning can be observed in students' course projects that indicate the learning outcomes of higher-order thinking. I have collected students' artifacts of three course projects. The following most important positive results of the innovation on student learning have been observed.

- (1) Students have developed problem-based learning ability. They identify and solve pertinent business problems (e.g., business data processing and e-commerce websites) to learn the use of computer programming languages.
- (2) Students have developed self-regulation learning ability. They strive to search the best learning strategies on their own, and to be independent in completing the assignments.
- (3) Students have developed creativity skills. They have demonstrated motivation through searching for large project scopes and creative components for their assignments.

3. Potentials for Replication of the Innovation

Computer programming courses are offered in many disciplines other than our MIS program, including computer science, electronic and electricity engineering, sciences, etc. Although the subject of problem solving for each course is discipline-dependent, the general schemes of higher-order thinking and the teaching methodology are applicable across these computer programming courses. Accordingly, the present project of OFD Innovation in Teaching has direct potentials for replication in computer programming courses in other disciplines.

More generally, the shift of pedagogical paradigm from learning fundamentals alone to focusing on higher-order thinking can be implemented in any courses. The implication of this OFD Innovation in Teaching project for higher education is compelling that instructors need to identify unique higher-order thinking modes for her/his course, to design unique pedagogy to foster discipline-dependent higher-order thinking, and to develop specific higher-order thinking rubrics for assessment.