Development of a Teaching Model for Skill Transfer in Vocational Industrial Education

Boonthong Wasuri[1] and Pongpan Traimongkolkul [2]

ABSTRACT

Learning for transfer is a key target outcome of vocational industrial education. The main objectives of this research were to develop and assess effectiveness of the *Skill-Transfer Teaching Model* in vocational industrial education.

The research procedure consisted of three main steps: 1) conceptualization and design of the teaching model and research instruments, 2) field trial of the teaching model on the first sample of students, followed by model improvement; and 3) actual experiment conducted on the second sample to assess effectiveness of the teaching model. Both samples were students majoring in industrial technology enrolling in the 2001 and 2002 academic years at Nakhon Pathom Rajabhat Institute. Data collection and analysis were approached with quantitative methods, supplemented with qualitative methods. Effectiveness of the teaching model was assessed on three components of learning achievement, namely, knowledge, skill, and skill transfer.

The findings can be concluded that: 1) from effect size analysis, the skill-transfer teaching model was effective on *skill* and *skill transfer*, but not on *knowledge*; 2) from problem-solving pathway analysis, different patterns existed between students with different levels of prior knowledge, mechanical aptitude and achievement; and 3) the students expressed their overall satisfaction on learning activities provided through the teaching process.

Recommendations were proposed to enhance effective applications of the teaching model for students with deficiency in academic background. Further studies were also recommended for model refinement to be used with different levels of vocational industrial students.

Key words: teaching model, vocational education, industrial education, learning transfer, skill transfer

INTRODUCTION

Relevant education is the key to successful vocational training in the competitive world of work today. One of the most important concern in vocational education is how to guide students in applying knowledge to real-life situations (Borich and Tombar, 1995). Teaching for transferability of knowledge and skill is therefore essential for vocational education. Effective teaching strategy is an essential tool to prepare students for learning transfer and problem solving (Schunk, 1991; Gredler, 1997).

Skill transfer is the linkage of prior knowledge with neo knowledge, achieved from an integration of knowledge and skills, for applications to extended situations in a different context (Levy, 1993 cited in Burke, 1995; Agg, 1999). The extent to which skill

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transfer can be achieved depends on individual potentials, which can be enhanced through the process of learning for transfer (Wiseman, 1967; Cronbach and Snow, 1981).

Successful teaching for transfer requires that students be prepared with supported knowledge and skills necessary for particular situations. From past research on teaching, influential variables for effective teaching are: teacher variables, student variables, learning environment variables and learning process variables. Management of these variables is important to achieve desirable learning outcomes (Caroll, 1963; Klausmeier and Goodwin, 1966; Dunkin and Biddle, 1974; Bloom, 1982).

Teaching model is a set or a pattern of related instructional components with specified goals for teachers to create a desirable learning environment in classrooms or other specific learning contexts (Brady, 1985; Joyce and Weil, 1986). Good teaching model can guide students to construct important concepts and to achieve learning outcomes in cognitive, psychomotor and affective domains. Students then can proceed successfully to the step of problem solving. Systematic design of teaching model will ensure that such desirable outcomes will come under well-prepared learning environment. (Rieser and Dick, 1996).

To meet the goal of preparing students for the world of work, research on teaching for transfer is much needed in vocational education. This research is an experimental study, aimed for the following objectives:

1. To develop a skill-transfer teaching model in vocational industrial education.

2. To assess effectiveness of the teaching model on three components of achievement, namely, knowledge, skill, and skill transfer.

3. To secure reflections of the learners on the learning activities designed in the teaching model.

METHODS

Research design

The research procedure consisted of three main steps, as follows:

1. Conceptualization and design of the teaching model and research instruments. This was achieved from a synthesis of theoretical foundations and concepts in vocational teaching. Alternative teaching models were extensively explored.

2. Once the model was derived, a field trial was performed on the first sample of students, followed by a minor improvement.

3. Actual experiment was conducted on the second sample to assess effectiveness of the teaching model.

To control for manipulation consistency, the researcher served as instructor for the field trial as well as the actual experiment.

Data collection and analysis

Two samples from Nakhon Pathom Rajabhat Institute[1] were used in this study. The first sample (n=21) was used to determine feasibility of the first draft of the teaching model. The second sample (n=30) was the actual experimental group to assess effectiveness of the improved teaching model. Both samples were students majoring in industrial technology in the 2001 and 2002 academic years, consecutively.

Data were collected with quantitative methods, supplemented with qualitative methods. Instruments used for data collection were: mechanical aptitude test, knowledge test, skill test, skill transfer test, questionnaire, and student journal. In addition, the researcher-instructor conducted direct observations and individual interviews during the experiment. For data analysis, descriptive statistics and effect size estimation were used for quantitative data; and content analysis for qualitative data.

1 Nakhon Pathom Jajabhat University at present

FINDINGS AND DISCUSSION

The Skill-Transfer Teaching Model

The first draft of the skill-transfer teaching model was derived through a synthesis of related theories and concepts. This preliminary model was subject to a field test on the first sample of the target students. Upon assessment and improvement, the second and final draft of the model was used on the actual sample.

The finalized teaching model characterizes a systematic process of teaching and learning, with essential elements of preparation, teaching procedures, evaluation and reflection. The teaching process as specified in the model consists of 3 components/ steps, namely, *orientation, formation of basic concepts and skills,* and *learning for skill transfer.* (Figure. 1) The three components are briefly described as follows:

Orientation. The teacher begins each unit by motivating and re-orienting students with prior knowledge. Concept checks at this stage provide information for the teacher to reinforce students on essential knowledge required for further learning.

Formation of basic concepts and skills. This second step involves the learning of underlying content, which then serves as background knowledge for skill learning. Practices of skills are achieved through group cooperative work with job sheets under the teacher's guidance-- the routine procedures for vocational practices. Skills were later enhanced through individual self-directed practices and assessment. To complete the learning process, teacher engages students in reflections.

Learning for skill transfer. This is the key element of the teaching process. Problem-solving approach is applied at three levels through cooperative group learning. First, at *schema accretion level*, basic problem-solving tasks are assigned. Secondly, at *schema evalution level,* higher levels of problem-solving tasks are assigned. Lastly, *at schema creation level*, more complex (*analogy level*) problem-solving tasks are assigned. Students are expected to transfer their knowledge and skills through such sequential activities.

Profile of the experimental group

Backgrounds on academic and mechanical aptitude of the experimental group were obtained from scores on the institutional admission test. *Table 1* reveals that average prior knowledge was low on Mathematics, Sciences, and English (21.68% of the total). Average prior knowledge on Electronics was relatively higher (32.95% of the total), but also at a low level. On the other hand, average score on mechanical aptitude was more satisfactory (69.67% of the total). The data reveal that, on the average, the experimental students are sufficient in mechanical aptitude; but deficit on academic background.

Experimental outcomes

1. Learning achievement

Three learning outcomes were assessed from the experimental application of the Skill-Transfer Model: *knowledge, skills*, and *skill transfer.* Description of scores is based on the following scale:

80 and above	excellent
70-79	good
60-69	moderate
below 60	low

Posttest scores (*Table 2*) revealed that learning outcomes of the experimental group was more favorable on skill and skill transfer than on knowledge.

Knowledge. Knowledge gain from the pretest and posttest scores was acheived. However, the posttest mean score was *low* (47.33 % of total score).

Skills. Posttest mean score on skill was at a *good* level (73.57% of total score).

Skill transfer. Posttest mean score on skill transfer was at a *moderate* level (68.93% of total score).

2. Effect size

Using achievement scores from a related course on industrial technology as a criterion score,

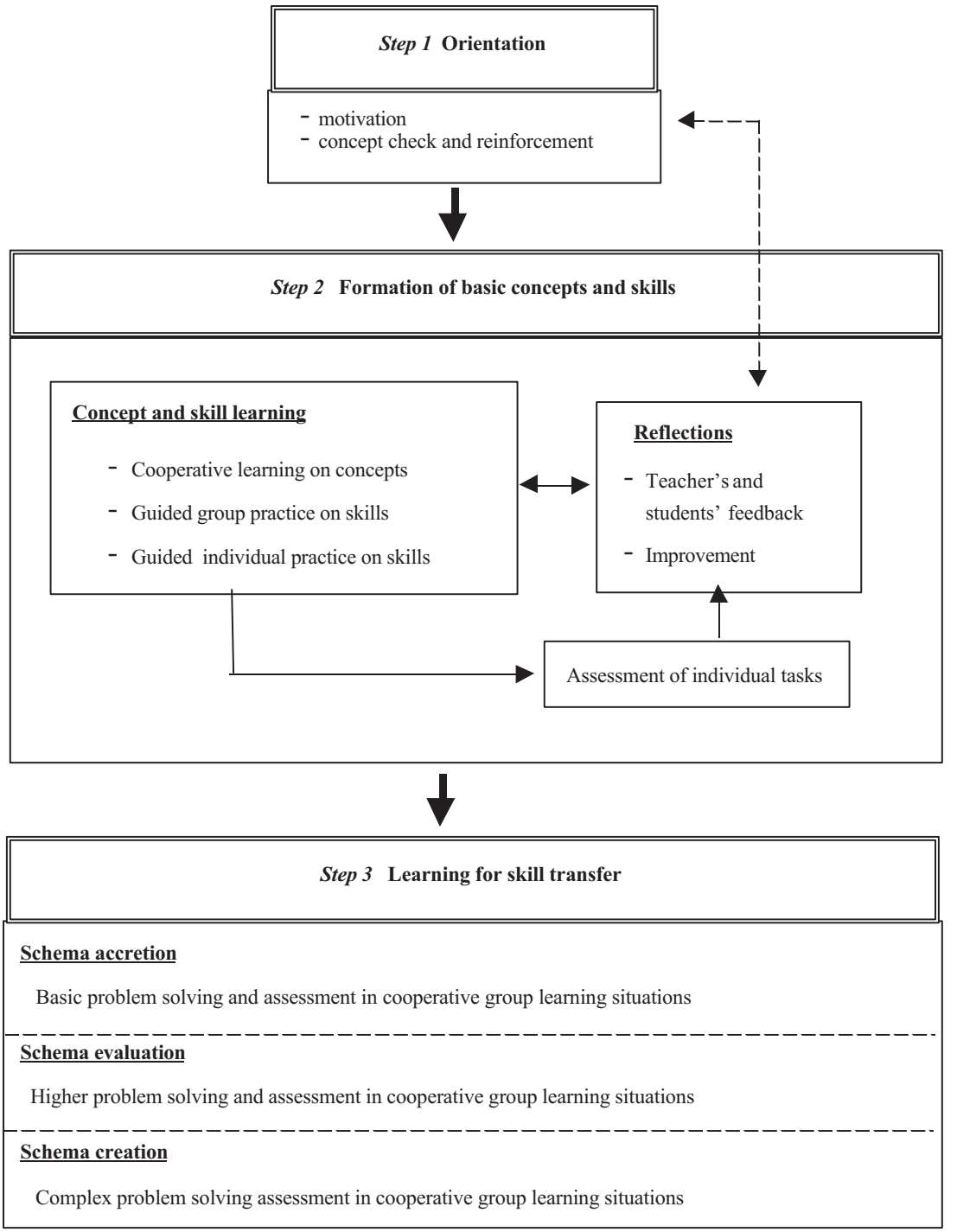

Figure 1 Components of the Skill-Transfer Teaching Model.

effect size indexes were calculated to determine effectiveness of the teaching model regarding the three learning outcomes. From the effect size indexes (*Table 3*), the model was effective considering achievement of students in *skill* and *skill transfer*, but not in knowledge.

The results revealed that the experimental group performed satisfactorily on skill and skill transfer despite their deficit on content knowledge. The fact that the subjects were mostly under-achievers in academic background partly explains the result on knowledge outcome. The results further implied that the students were practical-oriented, as suggested by their background in mechanical aptitude. Their applications of learned concepts to skill-based tasks were limited only to *practical* knowledge.

3. Problem-solving pathways

Based on interview data, descriptive analysis of problem-solving pathways of individual subjects was performed on *knowledge schema* and *skill schema*. The information provided a further understanding on different natures of transferability among students with different backgrounds.

The analysis revealed that different patterns existed between learners with different levels of prior knowledge, mechanical aptitude, and achievement. The higher-achievers tended to be more self-dependent in their problem solving, with fewer steps and more accuracy in the process. The lower achievers, on the other hand, were not self-dependent, using more steps in the same problem-solving task. This could be explained theoretically that higher achievers have more complex cognitive

Table 1 Background scores of the experimental group.

(n=30)

Background	Total score	$\overline{X}$	SD	%Total	Min	Max
Mathematics, Sciences, and English	100	21.68	3.74	21.68	14	29
Electronics	60	19.77	4.07	32.95	14	31
Mechanical aptitude	100	69.67	9.94	69.67	39	85

Table 2 Scores on knowledge, skill, and skill transfer of the experimental group.

(n=30)

Scores	Total score	Min	Max	$\overline{X}$	%total	SD
Knowledge						
-Pretest	60	14	31	19.77	32.95	4.07
-Posttest	60	21	41	28.40	47.33	7.58
Skill	54	30	48	39.73	73.57	4.95
Skill transfer	81	41	69	55.83	68.93	7.38

Table 3 Effect size indexes on knowledge, skill, and skill transfer.

(n=30)

Items	Total score	$\overline{X}$	SD	Effect size
Criterion score	100	56.90	5.70	-
Knowledge score	60	28.40	7.58	-1.68
Skill score	54	39.73	4.95	2.93
Skill transfer score	81	55.83	7.38	2.11

schema and can readily transfer their knowledge and skill in problem solving (Ausubel, 1968; Novak, 1981).

4. Students' reflections

During the experiment, students were asked to write journals, reflecting on the teaching-learning activities for each session. In the last session, upon completion of the experiments, questionnaires were used to obtain students' responses on the course as a whole.

Students expressed their satisfaction on most aspects of the learning activities. In their opinions, the strengths of the learning process were the introductory concept formation and the group work on scientific problem solving, supplemented by individual practices. Among the weak points was time duration involved in the learning activities, whereas details were lacking on the content.

CONCLUSION

The skill-transfer teaching model for vocational education was developed on the basis of theoretical concepts, and was empirically tested. Used with lower achievers, this model worked satisfactorily for the learning outcomes on *skill* and *skill transfer*. The model was not effective for this sample regarding the knowledge outcome. The students' feedback was preferable. Figure 2 summarizes the presage-process variables and key outcomes of the model.

IMPLICATIONS

The skill-transfer teaching model developed from this research is an illustrative design of learning environment for teaching vocational students to apply knowledge and skills. Results from the experiment indicated that the model needs to be further refined to work more efficiently with different levels of vocational industrial students. Further study is therefore recommended, employing classroom action research to explore alternative strategies and techniques in actual situation.

Prior knowledge of students is requisite to more successful applications of the skill-transfer model. Students with weak prior knowledge would

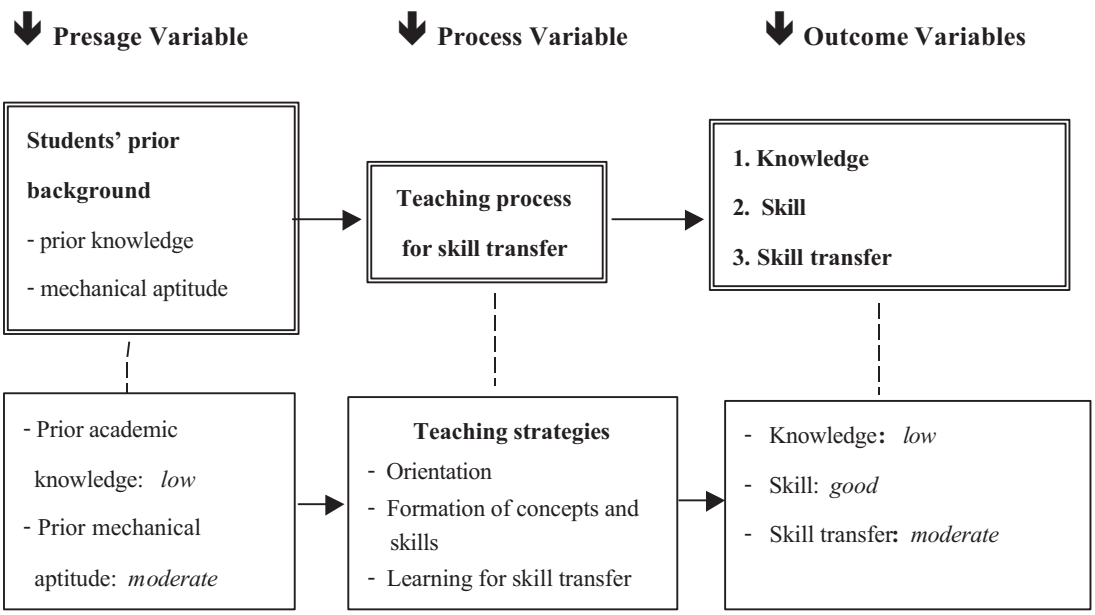

Figure 2 Summary of the presage, process, and outcome variables of the *Skill-Transfer Teaching Model.*

likely benefit less from the learning activities suggested in this model. When working with students with knowledge deficiency as in this experiment, it is imperative that reinforcement of essential concepts must be strengthened during orientation stage of the teaching process.

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LITERATURE CITED

Agg, P. D. 1999. *An Instructional Design Model for Training Prepress for Craft Workers in the Printing and Publishing Industry*. Illinois: Doctoral Dissertation, Illinois State University.

Ausubel, D. P. 1968. *Educational Psychology: A Cognitive View*. New York: Holt, Rineheart and Winston.

Bloom, B. S. (ed.). 1982. *Human Characteristic and School Learning*. New York: McGraw-Hill Book Company.

Borich, D. G. and L. M. Tombar. 1995. *Educational Psychology*. New York: Harpercollins College Publishes.

Brady, L. 1985. *Models and Methods of Teaching*. Sydney: Prentice-Hall of Australia.

Caroll, J. B. 1963. "A Model of School Learning". *Teacher College Record*. 64 (1): 723-733.

Cronbach, L. J. and R. E. Snow. 1981. *Aptitude and Instructional Methods: A Handbook for Research on Interactions*. New York: Irvington Publishers.

Dunkin, M. and B. Biddle. 1974. *The Study of Teaching*. New York: Holt, Rinehart and Winston.

Gredler, M. E. 1997. *Learning and Instruction: Theory into Practice*. (3rd ed.). New Jersey: Prentice-Hall.

Joyce, B. R. and M. Weil. 1986. *Models of Teaching*. (3rd ed.). New Jersey: Prentice-Hall.

Klausmeier, H. J. and W. Goodwin. 1996. *Learning and Human Abilities: Educational sychology*. (3rd ed.). New York: Harper and Row Publishing.

Levy, M. 1993. *Work-Based Learning and Outcomes*. Cited in J. Burke (ed.). 1995. *Outcomes, Learning and the Curriculum Implications for NVQs, GNVQs and Other Qualifications*. Washington: The Falmer Press.

Novak, J. D. 1981. "Applying Learning Psychology and Philosophy of Science to Biology Teaching". *The American Biology Teacher*. 43(1): 12-20.

Reiser, R. A. and W. Dick. 1996. *Instructional Planning: a Guide for Teacher*. (2nd ed.) London: Allyn & Bacon.

Schunk, D. H. 1991. *Learning Theories: An Educational Perspective*. New York: Macmillan Publishing Company.

Wiseman, S. 1967. *Intelligence And Ability*. Victoria: Penguin Books.