CONCEPTUAL CHANGE IN ACCOUNTING EDUCATION

Essential part of the dissertation of A.T.J. Vernooij.
Presented September 1993 at he Erasmus University of Rotterdam.

A summery in English of the dissertation can be found at:
https://www.fons-vernooij.nl/proefschrift/Summary.pdf

ABSTRACT:
I: Solving computational problems in accounting requires the application of general rules in specific situations. Mistakes in the solution process may occur if the problem solver has his own interpretation of these general rules. These findings are about the performance of students when inconsistent conceptual frameworks in accounting are offered to them.

II: In a pilot-study amongst 29 Dutch students, it was found that many of these students did not accept the existence of more than one conceptual framework. To reconcile seeming inconsistencies, they created some kind of consistency of their own. These conceptual changes were similar between students. In fact, they developed personal interpretations and created a mental framework, leading to characteristic mistakes in the computations that followed the instruction.

III: In a survey of 155 students two groups were compared in a pretest-posttest control group design. The control group received instructions in the usual way with clear computational examples but with hidden general rules. The experimental group received instructions with diagrams making the general rules explicit. The hypothesis was that the experimental group would preform better than the control group in acquiring correct conceptual frameworks. The test resulted in a significant difference in favor of the experimental group.

IV: But the experiment showed as well that both the experimental group and the control group created more often a mental framework of their own.

CONCEPTUAL CHANGE IN ACCOUNTING EDUCATION

INTRODUCTION

The purpose of this study is to investigate whether explicit instruction in accounting procedures results in better understanding of the differences between financial accounting and cost accounting than implicit instruction. Implicit instruction uses examples of accounting problems and present possible solutions. Explicit instruction stresses the importance of examples as particular instances of general rules.

For that reason explicit instruction tries to focus attention on the relationships between examples and general rules in order to support the learning process on two levels of abstraction (Merrill 1983). To find out which mode of instruction is most effective a survey was done under 155 students (Author 1993a). The research not only measured whether the students acquired new knowledge, but as well how the students integrated the new knowledge with the knowledge acquired in an earlier stage of instruction.

The experiment investigated the process of cognitive elaboration (Shuell 1988) in a situation where accounting procedures from cost accounting are presented, once basic knowledge about financial accounting is acquired. In a pilot-study (Author 1993b, 1993c) it was found that students assumed consistency in the accounting procedures from these two disciplines. Many of these students were not able to accept the existence of different frameworks of thought (Vosniadou 1994). This resulted in characteristic mistakes in solving problems in both financial accounting and cost accounting.

The research program was designed at high school-level in Holland. At Dutch high schools a general introduction in accounting is offered by presenting different disciplines within one course. The results at examinations are rather poor, raising the question why students make so many mistakes in solving accounting problems. A survey of 155 students was undertaken to find out whether these students were able to cope with accounting procedures from different disciplines. The hypothesis was that explicit information about the differences would lead to a better structure of knowledge than implicit information.

This article starts with an evaluation of some modes of instruction from the perspective of cognitive psychology. Then, a description is given of the interdependency of conceptual models and a problem solving strategy in accounting. This analysis is followed by two examples of fragments from accounting models, which were subject of the instruction process and which have been incorporated in the research program (Horngren and Foster 1991; Hoogheid and Fuchs 1987).

The original models were made explicit with the Elaboration Theory of Instruction of Reigeluth and Stein (1983; author 1990). After that, a short description follows of the way students in the research program have built mental representations of these accounting models. Finally the design, the results and the conclusions of the research are presented.

THEORETICAL BACKGROUND

The current instructional mode in accounting is focused on presenting information by examples and opportunities for practice, assuming that students will somehow learn from these experiences (Choo and Tan 1995). The Bedford Committee's special report noted already before that this type of education should not dominate the instructional mode in the future (AAA 1986). Instead, more attention should be paid to expert learning and problem solving strategies (Mayer-Sommer 1990).

The skill of learning to learn (AECC 1990), should play an important role in the instructional mode. Choo and Tan (1995) reported positive effects on cognitive elaboration on students ability to use problem solving strategies. This supports the idea that more strategic knowledge is required (Author 1995).

Little educational research has been done in the field of computational problem solving in accounting. However, much research is available from sciences like mathematics (i.e. Polya 1954; Anderson 1982 1985) and physics (i.e. Mettes and Pilot 1980; Larkin 1983; Mettes 1985; T. de Jong 1986; Ferguson Hessler 1989). Authors from those disciplines argue that there are four stages in solving a problem. These stages are: orientation on the problem situation, analysis of the problem structure, planning of the solution, and calculation of the answer.

Schoenfeld (1989) suggests to take a fifth stage into account: evaluation of the problem solving process after the answer has been found. This stage must show the importance of considering both the solution and the process of finding the solution. Veenman (1993) explored this metacognitive skill and found it makes an independent contribution to success in solving problems.

Every discipline in science has its own procedures of which particular instances can be derived. Norman, Gentner and Stevens (1976) refer to procedures as 'conceptual models'. Every particular instance can be derived from a conceptual model by filling up certain quantities with a given value or a default value (which is usually 0). This implies that analyzing a particular problem consists of finding the relationship between this problem and the conceptual model behind it.

Norman (1983) mentions the difference between two kinds of knowledge: the *conceptual models* offered to students in the instruction material and the *mental models* students actually develop in their minds. He indicates that success in solving problems depends upon the relationships between the conceptual models offered and the mental models developed. Every model exists at two levels: a general model at an abstract level and a specific model in a concrete situation.

Williams, Hollan & Stevens (1983) indeed describe some examples of mental models students developed on electricity while solving problems. These mental models were quite different from the conceptual models offered to them. Depending upon the type of misconception a student developed, predictions could be made about the kind of mistakes that would occur in the solution of specific problems.

In physics it was found as well that experts categorize scientific concepts different from novices (Chi, Feltovich and Glaser 1981). Novices concentrate on superficial resemblances while experts classify them on similarities in problem solving methods. Larkin (1983) showed how differences in the problem-solving performance of experts and novices can be related to the use of different problem representations. Experts in physics are able to create a *physical* representation that contains imagined entities such as forces and moments, before they construct their mathematical equations.

Glaser and Bassok (1989) studied the way experts develop their expertise by compiling useful procedures. Experts are able to reassign a concept from one category to another (Chi, Slotta, and De Leeuw 1994). They are able to transform initial conceptions of concepts into scientific conceptions. This skill is called conceptual change. Novices do not (yet) possess this skill. They assume consistency and create misconceptions by trying to synthesize different frameworks (Vosniadou 1994). This way they create mental models that leads them astray.

PROBLEM SOLVING IN ACCOUNTING

Accounting consists of different disciplines, like financial accounting, cost accounting, and commercial accounting. All these disciplines have their own habits and concepts. Their vocabularies are not always consistent with one another. To tackle a certain problem from the angle of a specific discipline, a choice of the correct concepts and the correct relationships between them is required. This implies a correct view on conceptual models that are required within each discipline.

Conceptual models in accounting give a description of the correct computation of important economic quantities. Mostly, these models are not offered as entities but as fragments hidden in examples of particular instances. Students have to build the accounting models by themselves. They are left with their own mental models. Still, the building process should result in correct copies of the hidden conceptual models. If this is not the case, students have an incorrect starting point in analyzing a specific problem. This could result in mistakes in the solution process.

In solving a problem in accounting on the basis of economic insight, the four stages of the problem solving strategy must be worked out. The stage of *orientation* is aimed at interpreting the accounting discipline involved, the type of company under consideration and the meaning of the concepts used in the problem statement. The *analysis* is aimed at grasping the problem structure, that is to say at the discovery of the relationships between the data and the unknown. This stage embraces two activities. The first is the search for the general conceptual model behind a certain problem. The second is the transformation of this general conceptual model into a specific model required for solving the problem.

This specific model can be presented in schematic form, resulting in an actions diagram (Author 1990). Once the relationships between the data and the unknown are clear the *planning* of the solution is possible by selecting and ordering the steps required to compute the correct answer. Then the final *calculations* can be made and controlled.

The essential point in the problem solving process in accounting is the first activity in the analysis. The students have to find the correct conceptual model behind a certain problem. But as mentioned before, students develop their own mental models of the conceptual models offered to them in the instruction process.

If these mental models are not correct, the students start from a wrong position. It will then be very difficult for them to construct the correct specific model required to compute the right answer. Therefore, teachers must control the development of mental models while students are working through examples of accounting procedures.

To improve the quality of accounting education it is important to discover possible causes for misconceptions while students build up their mental models. One possible cause is the existence of different frameworks belonging to different disciplines, where students expect consistency and uniformity in knowledge structures within accounting.

CONCEPTUAL MODELS

As mentioned before, the instruction mode in accounting is often based upon the use of examples. Many of those examples have the same structure: some data are provided and students are invited to answer some questions, which could be either a verbal reasoning or a computation of one or more unknowns. In Figure 1 an example is given of a simple computational problem.

Figure 1: example of a case study

A trading company has gathered the following information for June:

a. sales	= 20.000 products
b. selling price	= \$ 40.00 each
c. cost price	= \$ 30.00 each
c. purchasing costs	= \$ 25,000
d. overhead costs	= \$ 125,000

Required:

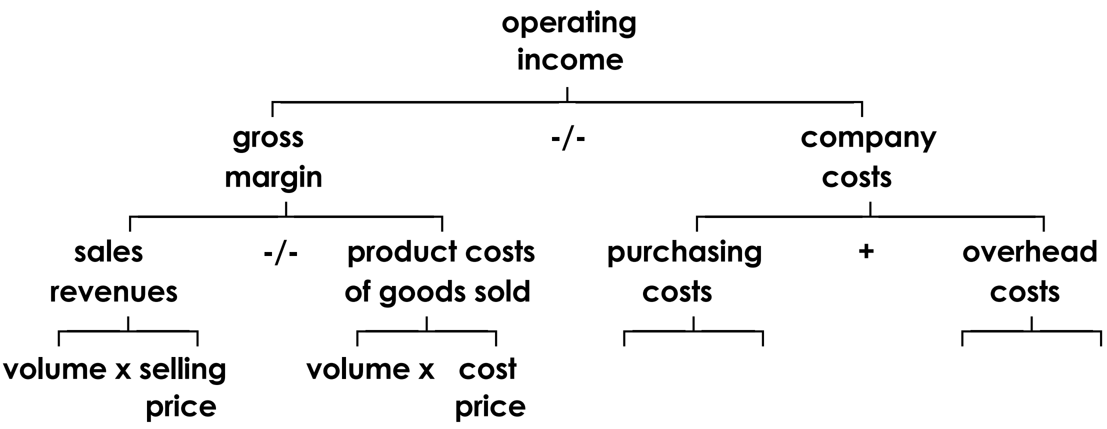
1. Compute the gross margin in June;
2. Compute the operating income in June.

In the presentation of this problem the functional relationships between the data and the unknowns are missing. To solve the problem, students will have to remember some general rules about how to relate the economic quantities to one another in the given situation. They should start their problem solving process by ignoring the numbers and concentrating on the names of the quantities involved.

At this point insight is required into the prescriptions hidden in the names of the concepts. The teacher's goal is to have the students demonstrate their knowledge of the general rules about relating the data and the unknowns in a specific situation: the transformation of a general conceptual model into a specific conceptual model needed to solve the problem.

The generally accepted accounting principles for financial accounting in Holland prescribe a combination of data as presented in Figure 2.

Figure 2: Conceptual model of the computation of operating income in a trading company according to financial accounting



To discover the functional relationships as described in Figure 2 students have several options. They might try to remember a similar problem they have seen before and trace the required relationships. (Notice that if they know the solution already the exercise is not a real problem anymore). Or they might take a smart guess by choosing the most obvious computations.

If they don't know the solution of a problem at all they might try to take a look in the book with answers, if available, or await the teachers explanation. But these solutions are not really contributing to the development of economic understanding. To attain insight students should search in a textbook for a description of a more general procedure behind the required computation.

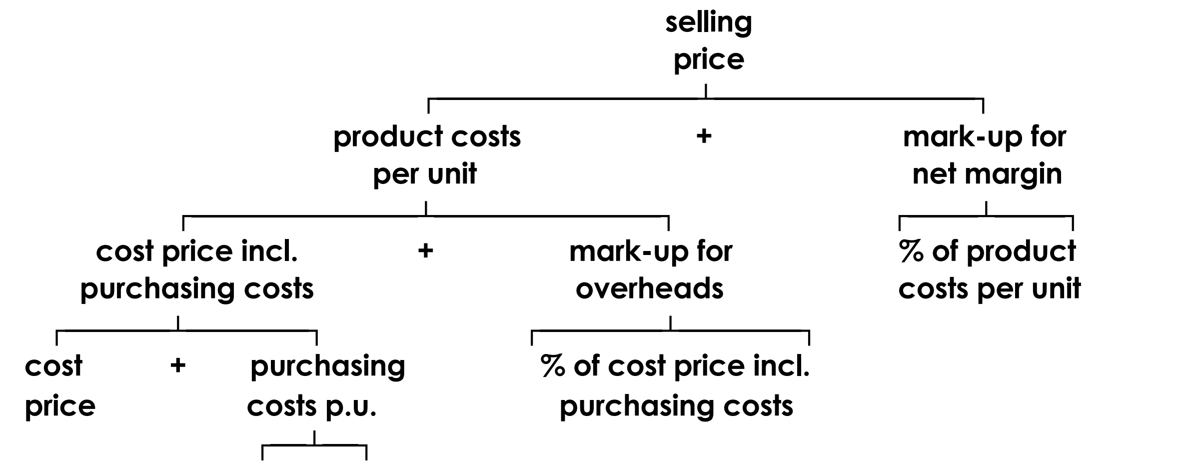
Instead of examples, stories could be presented to students explaining how entrepreneurs are selecting data required to solve problems. These stories could be summarized in diagrams. Figure 2 presents a fragment of a broader conceptual model that can be referred to in solving the presented problem.

The variable at the top of the model is a concept that is of great importance to an entrepreneur. Top down the required information in computing the value of this variable, can be described. Many of the quantities mentioned can be further described as computations of subordinate quantities.

To solve the problem presented, students must try to discover the correct general conceptual model behind this problem before they can transform this model into a specific model required to solve the problem. They must form a problem representation in economic terms. Therefor they need to know what prescriptions to use in combining the different economic quantities to one another. If they mix up prescriptions from financial accounting with prescriptions from cost accounting incorrect models result.

In Dutch textbooks financial accounting and cost accounting differ in their definition of 'product costs'. This is similar to the American situation where Horngren & Foster (1991, 44) introduce different ways of computing the 'product costs'. The *product costs* of goods sold for the yearly income statement (see Figure 2: financial accounting) is of a different structure than the *product costs* in calculating the selling price (see Figure 3: cost accounting).

Figure 3: Conceptual model of computing the selling price in a trading company according to cost accounting



To find the answers on the study problem presented in Figure 1, students must know which interpretation of 'product costs' to use. According to financial accounting the operating income in June is $ 50,000, but if the product costs of goods sold is supposed to include both purchasing costs and overhead costs the operating income is $ 200,000.

Other interpretations are possible, such as a double subtraction of purchasing costs and overhead costs when they are first incorporated in the product costs per unit according to Figure 3 as part of computing gross margin. Then students could subtract them again in computing the operating income according to Figure 2. The predictable mistake is then a loss of $ 150,000.

MENTAL MODELS

The most interesting question concerning educational research in accounting, is how students cope with inconsistent conceptual models. Do they consider them as separate entities which must be applied in different situations, thus creating two different mental models? Or do they try to build a consistent mental model in their minds, thus mixing up conceptual models that should be kept separate?

In the research program, preliminary information about the possible mental models was gathered with the help of think-aloud protocols (Ericsson and Simon 1984) and with the performance of a pilot study in a group of 29 students in the age of 15 to 16 year old.

In this pilot study it was found that many students tried to integrate the different conceptual models offered to them. They expected consistency in the textbooks. As this consistency was absent, students tended to create it themselves. One mental representation found in computing the product costs per period was: *volume times product costs per unit*. This resulted in a double subtraction of the purchasing costs and overhead costs.

However, some students found smart solutions. They discovered the double subtraction and redefined both the product cost per period and the product cost per unit. They developed a mental model for computing operational income which contained as 'product costs per period': *volume times cost price including purchasing costs per unit* (see Figure 4). And they developed a mental model for computing the selling price which contained as 'product costs per unit': *cost price plus purchasing costs per unit* (see Figure 5).

Figure 4: A mental representation of the computation of operating income in a trading company as an alternative model aimed at integrating the conceptual models offered

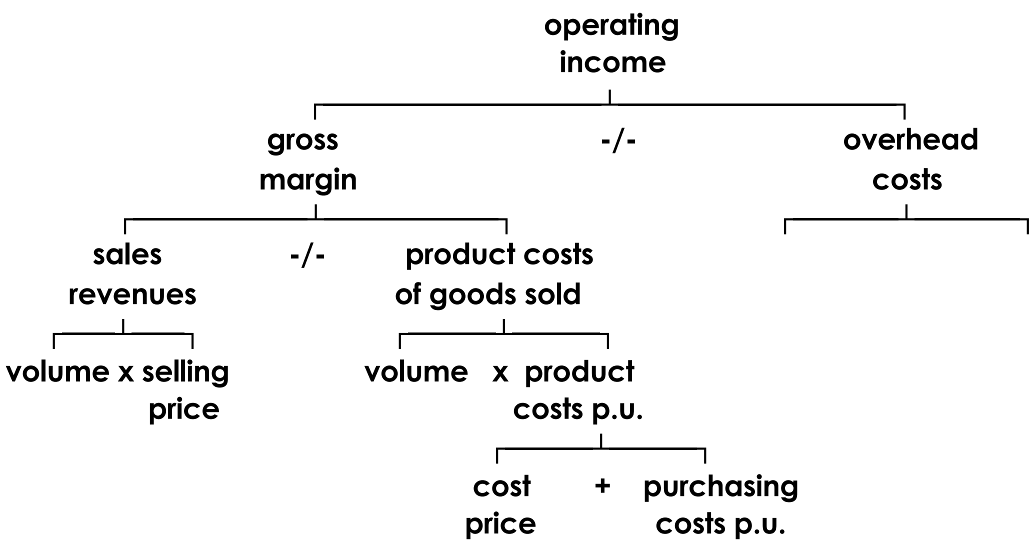
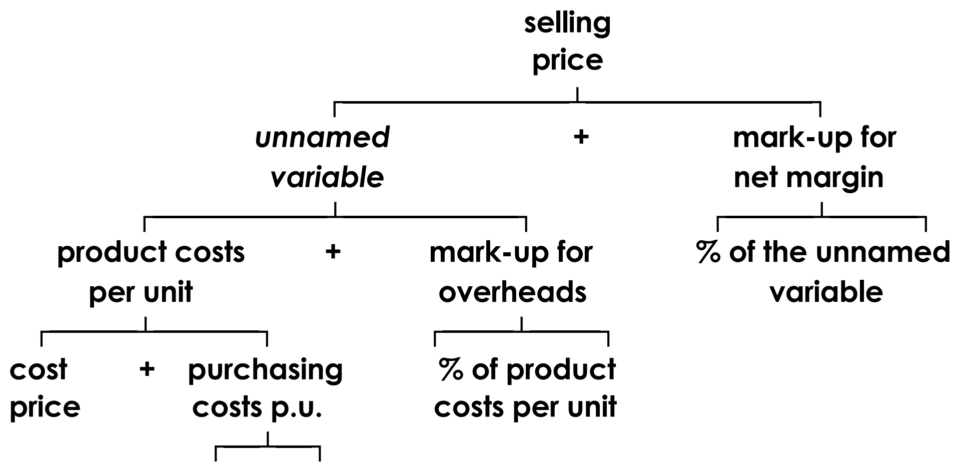


Figure 5: A mental representation of computing the selling price in a trading company as an alternative model aimed at integrating the conceptual models offered



These alternative approaches resulted in correct answers on both the computation of operating income and the selling price, but it created misconceptions (Taconis 1995) about the computation of product costs of goods sold and product costs per unit, resulting in a wrong answer on the question about gross profit per period.

To find a way of better supporting the learning process of students, a mode of instruction was developed that paid explicit attention to the differences in conceptual models. The expectation was that students would easier accept the inconsistencies between conceptual models if they were not longer left alone with their attempts to discover the hidden conceptual models in accounting problems presented to them.

This leads to the hypothesis that,

H1: Students who receive explicit information on conceptual models in accounting problems develop mental models that are a better representation of the conceptual models taught than students who receive implicit information.

METHODOLOGY

Choice of schools

To investigate the development of mental models once inconsistent conceptual models are offered, research was done at 6 secondary schools. In Holland secondary schools offer a thorough introduction in accounting by presenting different accounting disciplines within one subject. Textbooks alternate introductions in financial accounting, cost accounting, and marketing. They thus offer an opportunity to find out how students cope with conceptual models that are not consistent with one another.

Subjects

Subjects were 155 students who had chosen accounting for their final examinations at secondary school. All students were in the age of 15 to 16. Time spent on homework was taken as a covariate in the analysis. To minimize incorrect answers from the students, the system of time-registration was set up in a way that the teachers did not get any information about their reports.

Research design

The design of the research program was a pretest-posttest control group design. The control group (80 students) was treated with the implicit mode of instruction: demonstrations of computations containing implicit conceptual models. The experimental group (75 students) was treated with the explicit mode of instruction: demonstrations of actions diagrams making the conceptual models explicit.

The experiment was situated in a realistic situation, where the results on the tests were incorporated in the normal grading system. The teachers of the experimental group received extra instruction about the new approach. The teachers of the control group applied the normal way of instruction.

Materials

The material consisted of a chapter from a regular Dutch textbook (Hoogheid and Fuchs 1987) containing two paragraphs with separate topics: the computation of the selling price of a product in a trading company and the computation of the break-even point. Before the experiment started, all students followed the lessons about financial accounting. These lessons were given in the usual implicit way of instruction.

Testing

Testing was performed three times: before the chapter was introduced, after the introduction of the computation of the selling price and after the introduction of the break-even analysis. The first test measured the knowledge of the students after completing the introduction in financial accounting.

To measure the development of the knowledge of the students, four different tests were used and some think-aloud protocols were made. In this article, the results of one test only (Knowledge of Prescriptions) are presented. This test conceptualizes the mental models students developed while they were learning to solve the accounting problems. The test consisted of two parts (see appendix A).

The first part stated four questions (a. through d.) about knowledge acquired before the research started (i.c. computing operating income according to the rules of bookkeeping in financial accounting). The second part stated four questions (e. through h.) about the new knowledge to be acquired in the research period (i.c. computing the selling price of a product according to the rules of cost accounting).

Reliability

Two independent judges were asked to mark the statements found with codes referring to available conceptual models: B for the bookkeeping model according to financial accounting (see Figure 2), C for the cost per unit calculation according to cost accounting (see Figure 3), D for the direct costing model and A for the alternative model (see Figures 4 and 5). If an answer was missing or if it was impossible to identify, the judges marked it with an X.

Students who choose the right answer received two points if the answer was correct according to the conceptual model required and one point if it was recognizable but incomplete. The validity of the test was measured with Cronbachs alpha on an item-rest correlation. The reliability of the judgements was measured with Cohen's kappa. Both, validity and reliability, were found to be sufficient.

In analyzing the data one group of 25 students was found to produce errors at the first test which other groups only performed in the second test. Their results on the first test were deviating in a significant way from the results of the rest of the control group, whereas their results on the second and third test were similar. A thorough investigation led to the conclusion that these students received preliminary information on the new subject to be taught. The influence on the results of the first test made it necessary to exclude them from the statistical analysis.

RESULTS

The results of the test are presented in Tables 1 through 3. In the first test (Table 1) no significant differences were found between the experimental group and the control group, after exclusion of the group of 25 students. The score on the new topic, tested with item e. through h. is almost zero, as was expected. In this situation computing the standard deviation was irrelevant.

Table 1: Results on first test

	item a / d mean	s.d.	item e / h mean	s.d.	item a / h mean	s.d.
experimental group (n = 75)	3.3	2.1	0.2	-	3.5	2.1
control group (n = 55)	3.4	2.4	0.1	-	3.5	2.4

results ANOVA items a t/m d (n = 130): F (1,98) = 0.05; P ≤ 0.823*
* significance level: α = 5%

In the second test the experimental group performed better than the control group (see Table 2). The total score of the experimental group on the items a. through h. was significantly higher than the score of the control group. This difference is due to the score on the items about financial accounting acquired before the experiment. The score was equal on the items about the new knowledge. The same results were found at the third test (Table 3).

Table 2: Results on second test

	item a / d mean	s.d.	item e / h mean	s.d.	item a / h mean	s.d.
experimental group (n = 75)	3.0	2.4	3.8	2.2	6.8	3.2
control group (n = 55)	1.3	1.4	3.6	2.0	4.9	2.4

results ANOVA items a t/m h (n = 130): F (1,98) = 10.64; P ≤ 0.002*
* significance level: α = 5%

Table 3: Results on third test

	item a / d		item e / h		item a / h	
	mean	s.d.	mean	s.d.	mean	s.d.
experimental group (n = 75)	3.7	2.7	3.0	2.5	6.6	4.2
control group (n = 55)	1.1	1.2	2.7	2.0	3.8	2.3

results ANOVA items a t/m h (n = 130): F (1,98) = 5.91; P ≤ 0.017*

* significance level: α = 5%

DISCUSSION

To find an explanation for the results found, an analysis was made of the choice of models by the students in computing the product costs of goods sold (Table 4). This investigation includes the group of 25 students excluded in Tables 1 through 3.

Table 4: Registered codes on item a (product costs of goods sold)

	first test		second test		third test	
	EG	CG	EG	CG	EG	CG
model A	-	2	11	9	9	5
model B	*32*	*26*	*18*	*2*	*27*	*2*
model C	5	11	36	60	23	44
model D	-	-	-	6	1	3
rest	38	41	10	9	15	26

model A: alternative model
model B: bookkeeping model according to financial accounting (correct for this item)
model C: costs per unit calculation according to cost accounting
model D: direct costing model according to cost accounting
EG: experimental group (n = 75); CG: control group (n = 80).

In the first test 42% of the students of the experimental group produced the correct answer on item a. This percentage went down to 24% in the second test, but went up to 36% in the third test. Of the students of the control group 33% gave the correct answer on item a in the first test. In the second test this percentage went down to 3% and this didn't change in the third test.

The difference between conceptual models taught and mental models developed came to the front in the choice for model C. In the second test it was found, that 96 out of 155 students redefined the model B concept of 'product costs of goods sold' in a sense corresponding to model C (*product costs of goods sold = volume times product costs per unit*). This was done by 48% of the students of the experimental group. This percentage went down to 30% in the third test, because more students choose the correct answer.

In the control group 75 % of the students gave an answer referring to model C. In the third test the percentage of students of the control group went down to 55% but this was no indication they returned to the right model. Some of the students in the control group turned towards a mental model corresponding with the direct costing model, others developed a mental model too mixed up to categorize.

Furthermore is was found in the second test, that 20 students wrote down a mental model according to the alternative model. This number went down to 14 in the third test. The number of unidentified answers (X) went up from 19 in the second test to 41 in the third test. This indicates that the introduction of the conceptual model of direct costing resulted in a greater confusion.

Table 5: Registered codes on item e (product costs per unit)

	first test		second test		third test	
	EG	CG	EG	CG	EG	CG
model A	2	2	10	3	19	9
model B	19	6	-	-	1	1
model C	*3*	*12*	*52*	*67*	*42*	*52*
model D	-	1	-	-	-	3
rest	51	59	13	10	13	18

model A: alternative model
model B: bookkeeping model according to financial accounting
model C: costs per unit calculation according to cost accounting (correct for this item)
model D: direct costing model according to cost accounting
EG: experimental group (n = 75); CG: control group (n = 80).

A close examination of the answers on the computation of the product costs per unit (Table 5) reveals an expected result at the first test. As the new definition for product costs had not yet been introduced (except for one of the classes in the control group) few students indicated an answer according to model C while quite a few tried to interpret the concept in terms of model B. After introducing model C most students answered accordingly, but quite a few developed already the alternative model. In the third test the growth of representations fitting in with the alternative model is noticeable whereas the downfall in model C is evident.

CONCLUSIONS AND LIMITATIONS

In solving computational problems in accounting, students must read a text and interpret these texts with the mental models they have already in mind. If these mental models do not concur with the conceptual models required to solve the problems, systematic and persistent errors might occur in solving problems. For that reason the relationships between the conceptual models taught and the mental models acquired are an important subject to discuss.

In the research program, information was gathered about the way students cope with the inconsistent conceptual models offered. The hypothesis was that in the second and third test the experimental group would develop mental models that are a better representation of the conceptual models taught than students who receive implicit information. The results show that indeed a significant difference is found in favor of the experimental group. This difference however, was not due to a better score on the newly acquired knowledge, but on a better conservation of knowledge acquired in an earlier stage.

The most remarkable result is the variety in mental models that students developed as a reaction to the conceptual models presented. Most students did not accept the conceptual models as separate entities which must be used in different situations, but rather tried to integrate the models one way or another.

As the results demonstrate, many students tend to integrate competing conceptual models into one overall structure. This was confirmed in the other tests of the research program. Acquiring new knowledge may coincide with the destruction of old knowledge acquired earlier in the instruction process. It may coincide as well with the creation of new models never intended by the teachers. Therefore teaching and learning must be made concurrent. Where possible, the conceptual models must be made consistent with one another. Where impossible, the differences must be taught explicitly and not hidden in computations only.

The introduction of economic procedures from a different discipline requires the acceptance of a different framework of thought. Students must accept the existence of disciplines with their own conceptual models. This requires the skill of categorizing concepts within competing frameworks. Further research in conceptual change within the field of accounting may lead to better understanding of the problems students have in coping with this subject. Information about the learning process can thus improve the process of teaching.

The conclusions of this research are subject to several limitations. One limitation is the proposition of the existence of conceptual models. Is it really possible to presuppose the existence of conceptual models? Or are companies so different that there are only particular instances to describe (Cooper and Kaplan 1991; Ryan et al. 1993)?

Is it really true that disciplines differ in the use of concepts in such a way that characteristic conceptual models can be described, or is the given example an exception? Systematic research in the possibilities to categorize accounting procedures according to types of companies and kinds of disciplines must give more insight in the relevance of this type of research.

Another limitation is the small scale research program under 155 students in the age-category of 15 to 16. More research in other groups of the same age, as well as research in groups of undergraduate and graduate students is required to get a better view on the development of mental models. The results found, are restricted to the Dutch situation and could be used as an hypothesis to start similar research in other countries.

A third limitation is related to the theoretical background. Cognitive psychology itself is developing as a science. Conceptual change is subject to research and might offer new perspectives in the near future. Categorizing concepts and building mental models is part of a research in problem solving skills. The teaching of problem solving skills might redirect the attention of teachers from accounting habits into cognitive skills. This might imply a conceptual change for teachers as they are not supposed to concentrate their teaching on how to 'learn to account' but on how to 'learn to learn'.

APPENDIX A

The test Knowledge of Prescriptions

To compute the total amount of goods purchased in a period, a merchant needs two data: the number of products bought and the price per unit. The computation then takes place in the following way: *number of products bought* x *cost price per unit*.

How does a merchant normally compute:
a. the product costs of goods sold?
b. the sales revenues?
c. gross margin in a period?
d. operating income in a period?

How does a merchant normally compute:
e. the product costs per unit?
f. the selling price per unit?
g. the mark-up for overheads?
h. the mark-up for net margin?

Expected answers (see Figures 2 and 3):
a. the product costs of goods sold = volume x cost price per unit;
b. the sales revenues = volume x selling price per unit;
c. gross margin in a period = sales revenues - product costs of goods sold;
d. operating income in a period = gross margin - purchasing cost - overhead costs;

e .the product costs per unit = cost price + purchasing costs per unit + mark-up for overheads;
f. the selling price per unit = product costs per unit + mark-up for net margin;
g. the mark-up for overheads = mark-up percentage over (purchasing price + purchasing costs);
h. the mark-up for net margin = mark-up percentage over product costs per unit.

REFERENCES

Accounting Education Change Commission (AECC). 1990.Objectives of education for accountants.*Issues in Accounting Education* (Fall): 307-312.

American Accounting Association (AAA), The Bedford Committee. 1986. Future accounting education: Preparing for the expanding profession. *Issues in Accounting Education* (Spring): 168-195.

Anderson, J. R. 1982. Acquisition of cognitive skill. *Psychological Review*, (number 4).

Anderson, J. R. 1985. *Cognitive psychology and its implications,* New York: W. H. Freeman and Company.

Chi, M. T. H, P. J. Feltovich, and R. Glaser. 1981. Categorization and representation of physics problems by experts and novices, *Cognitive science* 5: 121 - 152.

Chi, M. T. H., J. D. Slotta, and N. de Leeuw. 1994. From things to processes: a theory of conceptual change for learning science concepts, *Learning and Instruction* (Volume 4, number 1): 27-43.

Choo, F. and K. Tan. 1995. Effect of Cognitive Elaboration on Accounting Students' Acquisition of Auditing Expertise. *Issues in Accounting Education* (Spring): 27-43.

Cooper R., and R. S. Kaplan. 1991. *The Design of Cost Management Systems*. Englewood Cliffs: Prentice Hall.

Ericsson, K. A. and H. A. Simon. 1984. *Protocol Analysis*. *Verbal reports as data,* Cambridge: MIT Press.

Ferguson Hessler, M. G. M. 1989. *Over Kennis en Kunde in de Fysica* (About knowledge and skills in physics), Eindhoven: thesis.

Glaser R. and M. Bassok. 1989. Learning theory and the study of instruction. In: *Annual Review of Psychology*, volume 40.

Hoogheid, J. C. and H. Fuchs. 1987. *Basisboek Bedrijfseconomie voor HAVO en VWO*. (Elementary accounting for secondary education), Groningen: Wolters-Noordhoff.

Horngren, C. T. and G. Foster. 1991. *Cost Accounting,* New Jersey: Prentice-Hall.

Jong, T. de. 1986. *Kennis en het oplossen van vraagstukken* (Knowledge and the art of solving problems). Eindhoven: thesis.

Larkin, J. H. 1983. The role of problem representation in Physics. In D. Gentner and A. L. Stevens (eds.) *Mental Models*. Hillsdale, N. J.: Lawrence Erlbaum Associates.

Mayer-Sommer, A. P. 1990. Substance and strategy in the accounting curriculum. *Issues in Accounting Education* (Spring): 129-142.

Merrill, D. M. (1983). Component Display Theory. In: C. M. Reigeluth & F. S. Stein (Eds.), *Instructional Design Theories and Models, An overview of their current status*. Hillsdale, N.J.: Lawrence Erlbaum Associates.

Mettes, C. T. C. W., and A. Pilot. 1980. *Over het leren oplossen van natuurwetenschappelijke problemen* (About the art of solving problems in physics). Enschede: thesis.

Mettes, C. T. C. W. 1985. *Factual and procedural knowledge: Learing to solve science problems*. Leuven: Paper for the First European Conference for Research on Learning and Instruction.

Norman, D. A. 1983. Some observations on mental models. In D. Gentner and A. L. Stevens (eds.) *Mental Models*, Hillsdale, N.J.: Lawrence Erlbaum Associates.

Norman, D. A., D. R. Gentner, and A. L. Stevens. 1976. Comments on learning schemata and memory representation, in D. Klahr (ed.), *Cognition and Instruction*. Hillsdale N.J.: Lawrence Erlbaum Ass.

Polya, G. 1954/57. *How to solve it, A new aspect of mathematical Method*, New York: Doubleday Anchor Books, Doubleday and Company, Garden City.

Reigeluth, C. M. and F. S. Stein. 1983. The Elaboration Theory of Instruction, in *Instructional Design Theories and Models. An overview of their current status*. Hillsdale, N.J.: Lawrence Erlbaum Associates.

Ryan, B., R. W. Scapens, and M. Theobald. 1993. *Research Method and Methodology in Financeand Accounting*. London: Academic Press.

Schoenfeld, A. H. 1989. Teaching Mathematical Thinking and Problem Solving, in L. B. Resnickand L. E. Knlopfer: *Toward the Thinking Curriculum: Current Cognitive Research*, Yearbook of the Association for Supervision and Curriculum Development.

Shuell, T. J. 1988. The role of the student in learning from instruction. *Contemporary Educational Psychology* (July): 276-295.

Taconis, R. 1995. *Understanding based problem solving*. Eindhoven: thesis.

Vernooij, A.T.J. 1990. A systematic problem approach in Business Administration, in J. M. Pieters, K. Breuer and P. R. J. Simons (Eds), *Learning Environments, Contributions from Dutch and German Research*. Berlin: Springer Verlag.

Vernooij, A.T.J., 1993, Het leren oplossen van bedrijfseconomische problemen, *dissertation*, University of Rotterdam. Zutphen: Thieme, ISBN 90-9006335-8 geb.

Vernooij, A.T.J.. 1993a. *Secondary education and the art of problem solving in Management Accounting*. Thesis written in dutch with a summary in english. Zutphen: Thieme.

Vernooij, A.T.J. 1993b. *The use of spreadsheets in business education.* Paper for the 5th Conference of theEuropean Association for Research on Learning and Instruction in Aix en Provence, France.

Vernooij, A.T.J. 1993c. *Spreadsheets as a medium to conceptualize mental models*. Paper for the 5th EARLI Conference in Aix en Provence.

Vernooij, A.T.J. 1995. Problem solving strategies. In: *Educational Innovation in Economics and BusinessAdministration: The Case of Problem-Based Learning* (ed. W. Gijselaers). Dordrecht: Kluwer Academic Publishers.

Veenman, M. V. J. 1993. *Intellectual ability and metacognitive skill: determinants of discovery learning in computerized learning environments*. Amsterdam: thesis.

Vosniadou S. 1994. Capturing and modeling the process of conceptual change, *Learning and Instruction* (volume 4, number 1): 45-69.

Williams, M. D., J. D. Hollan, and A. L. Stevens. 1983. Human reasoning about a simple physical system, in D. Gentner and A. L. Stevens (eds.) *Mental Models*. Hillsdale, N.J.: Lawrence Erlbaum Associates.