Using principles of cognitive psychology in accounting to facilitate student learning

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ABSTRACT

It is important for instructors to develop teaching strategies that facilitate the learning process. This paper describes principles of cognitive psychology that have been used in the teaching of bond amortization, unprofitable long-term contracts, cross-holdings in complex group structures and the retail inventory method with a detailed example of this approach for the latter concept.

Keywords: cognitive psychology, retail inventory method, bond amortization

INTRODUCTION

This paper describes teaching practices that utilize principles of cognitive psychology to enhance the student learning of a number of critical accounting concepts: the amortization schedule for bonds, the retail inventory method, unprofitable long-term construction contracts and cross-holdings in complex group structures.

Many accounting concepts involve the mastering of strategies in order to be solved. These problems have been described as either well-structured or ill-structured (Hatch, 1988). Ill-structured problems are encountered in everyday life and include problems that require opinions and are solved according to beliefs and judgments. Well-structured problems are problems that have a definite correct answer that the solver is required to find, usually with the application of the appropriate concepts. It is the latter type of problem that is of concern in accounting education. Solving these well-structured problems requires the student to make the connection between the solution requirement/s and his or her existing knowledge. Consequently, it is essential that students learn to represent problems in a way in which they can solve them (Jonassen, 2003). In addition, educators cannot teach students how to solve every individual problem that they will encounter. Instead, it is necessary to teach the skills required to transfer learning to different problem types. Hayes and Simon (1974) describe the solving of a problem as occurring in two interactive stages of understanding and solution.

Simon and Hayes (1976) identified two ways of representing problems in learning-to-reason tasks involving the transfer of knowledge: change problems and transfer problems. In variations of the same problem (i.e., isomorphic problems), the problem was presented with objects that were both "fixed" (the size of the globe the monster was holding, p. 168) and "variable" (the size of the monster depended on the size of the globe, p. 168). When solving the problem depended on correctly representing the order of the fixed object, it was a change problem (i.e., with the command "change X to Y", p. 168). In a change problem, the monster changed the size of the globes. However, when solving the problem depended on correctly representing the order of the variable object, it was a transfer problem (i.e., with the command "transfer A from X to Y", p. 168). In other words, the monster moved the globes to get them in the correct order. The researchers found that change problems were nearly twice as difficult to solve as transfer problems. They compared this to the problem of ordering the disks in the Tower of Hanoi problem where the goal is to arrange the disks by size on a series of pegs. In a transfer problem, one would solve the problem by moving the disks whereas in a change problem, one would solve the problem by moving the pegs (Kotovsky, Hayes, & Simon, 1985).

Often accounting concepts, such as those listed above, are taught as change problems with a consequential deleterious effect on student problem-solving. This paper demonstrates how to develop these accounting topics as transfer problems rather than as change problems. Restating the concepts as transfer problems facilitates student learning because it exploits the principles of prior knowledge to facilitate comprehension, the most important precursor to solving the problem (Simon & Hayes, 1976).

It is not claimed that transfer of learning is easy. On the contrary, strategies for transfer of learning have to be explicitly taught to be effective. However, reframing the issue as a transfer problem, rather than a change problem, has been shown to lead to more effective comprehension (Jessup, 2009).

LITERATURE REVIEW

An important component of the learning process is the ability of students to recall prior knowledge and to apply it to new situations or domains. This is known as knowledge transfer (see, for example, Detterman, 1993; Kimball & Holyoak, 2000) and it has been shown to reduce the time students spend learning and to improve their performance (Jessup, 2009; Novick, 1990).

A robust finding in prior research is that problem-solving strategies are not easily transferred to analogous problems presented in a different context. For example, Gick and Holyoak (1980) found that participants were unable to solve a new problem when it was presented as a military problem instead of a medical problem, even though the underlying structure of the problem was exactly the same. The different cover story results in either failure to recognize that the problem has the same structure or the interpretation that the new problem has a different structure (Bassok & Olseth, 1995). Recalling of prior knowledge, if not given a hint to use a prior framework, is poor (Holyoak & Koh, 1987; Novick, 1988; Ross, 1984).

Knowledge transfer requires some form of guidance or cueing from an expert (Black & Schell, 1995; Perkins & Salomon, 1989; Van Eck & Dempsey, 2002). This guidance can take the form of an analogy which takes an existing cognitive framework and applies it to a new domain (Lin & Singh, 2011). However, the use of explicit analogies to solve problems is not a strategy that is employed by novices (Needhan & Begg, 1991; Simon & Hayes, 1976) and novices do not take advantage of their prior knowledge base (Gentner, Loewenstein, & Thompson, 2003). The greatest cognitive difficulty for novices is that they cannot determine that the existing problem is structurally similar to a previous problem that has a known solution (Day & Goldstone, 2012; Kotovsky et al., 1985).

Domain knowledge is an important variable in problem-solving. Bassok and Olseth (1995) identified instances where knowledge transfer occurs. For example, in Experiment 3, they found that there was a high rate of transfer from economic to non-economic problems of similar underlying structure with different cover stories (investment values to ice melting). In addition (Experiment 4), transfer from physics problems to similarly structured economic problems was poor (12% of participants), whereas 50% of participants were able to transfer knowledge from economics to physics.

Accounting instructors are experts in their field and, as such, should develop teaching strategies which link an existing known cognitive framework to the current problem and thus enabling knowledge transfer by the students. This paper develops these strategies for the amortization schedule for bonds, the retail inventory method, unprofitable long-term construction contracts and cross-holdings in complex group structures.

BOND AMORTIZATION SCHEDULE

Often texts develop separate amortization schedules for bonds issued at a discount and for those issued at a premium (see, for example, Revsine, Collins, & Johnson, 2004; Porter & Norton, 2011). If this topic is viewed as a transfer problem, then there is no need to develop separate schedules. By utilizing the students' prior mathematical knowledge it is only necessary to develop a single framework for the amortization of bonds. The suggested framework is shown in Table 1 (Appendix).

RETAIL INVENTORY METHOD (RIM)

Intermediate accounting texts do an outstanding job explaining the last-in first-out (LIFO), first-in first-out (FIFO) and weighted average inventory valuation methods. The texts usually develop a framework to help explain these traditional valuation methods. (See, for example, Kieso, Weygandt, & Warfield, 2013; Nikolai, Bazley, & Jones, 2010; Spiceland, Sepe, & Nelson, 2013.) The discussion of the traditional inventory valuation methods is then typically followed by an explanation of the implementation of the lower of cost or market (LCM) requirement and inventory estimation techniques.

Thus students should have already developed a strong background in the application of the traditional inventory valuation methods by the time that they are introduced to the RIM. This traditional method is depicted in Table 2 (Appendix) for the weighted average cost method. Instead of capitalizing on this prior knowledge, textbooks often present the RIM using an entirely different model from that of traditional inventory valuation methods.

Typically students are introduced to the RIM using a framework as shown in Table 3 (Appendix) which shows the determination of the weighted average cost of ending inventory. Although the framework does bear some resemblance to that used in computing the traditional weighted average cost of inventory there is no effort to set up the RIM as a transfer problem utilizing the students' prior knowledge.

The framework used to link the RIM to the traditional inventory valuation knowledge base is shown in Table 4 (Appendix) for the weighted average method. It is emphasized in class that, instead of using the number of units to allocate the available-for-sale dollar amount between ending inventory and cost of goods sold, the RIM uses the retail dollar amount to achieve the allocation. Therefore in Table 4 (Appendix) the retail column replaces the unit column to emphasize this fact. Appendix 1 demonstrates the use of the proposed RIM method for LIFO and Appendix 2 demonstrates it for FIFO.

The link to the students' prior knowledge base is also highlighted in the determination of the net purchase amount which comprises the purchases, purchase returns, freight-in, insurance, net markups, net markdowns, abnormal losses and any other costs incurred in getting the inventory ready to sell. It is shown that if there is a known change in the actual units of inventory then there is a change to the dollar amount of the net purchases for both the retail and cost columns. If there is no impact on the number of units of inventory then the amount must be allocated to either the cost or retail column.

The incorporation of the lower-of-cost-or-market (LCM) requirement into the RIM analysis is usually achieved by using the framework shown in Table 5 (Appendix). This requires students to become familiar with a new framework.

In order to set up the LCM analysis as a transfer problem, the same suggested framework as described in Table 4 (Appendix) is used, but the cost-to-retail ratio is modified to incorporate the markdowns thus drawing on the students' prior knowledge of mathematical concepts. This is detailed in Table 6 (Appendix). The ratio is called the lower-of-cost-to-retail ratio and is equal to the available-for-sale cost divided by the sum of the available-for-sale retail plus the net markdowns. Thus the incorporation of the LCM analysis into the RIM is explained using the identical framework and modifying the allocation ratio.

UNPROFITABLE CONTRACTS

When discussing unprofitable long-term construction contracts using the percentage-of-completion method it is typical for texts to use a framework which results in the costs of construction amount being the balancing figure from adding the gross loss to revenue. By breaking out the costs of construction between the actual costs incurred during the year and the provision for future losses this becomes a transfer problem as the students already have prior knowledge of the computation of the actual costs of construction from the profitable contracts framework. Hathorn (2011) discusses this concept in more detail.

CROSS-HOLDINGS IN COMPLEX GROUP STRUCTURES

The typical order for teaching selected components of a business combinations course is step-acquisitions, cross-holdings in complex groups and finally reciprocal holdings. Each topic is taught using the change problem approach. If the order of presenting this material is re-arranged to cover reciprocal holdings prior to cross-holdings in complex groups, then the latter topic can be taught as a transfer problem since it builds on the knowledge base acquired from the prior concepts.

To illustrate, assume that Letore Company acquired a sixty percent interest in Ashif Corporation on January 1, 2008 and that Letore acquired a five percent stake in Dusel Company on January 1, 2009. Finally Ashif acquired a fifty five percent stake in Dusel on January 1, 2011. From the group perspective the acquisition of Dusel can be viewed as a step-acquisition employing the same principles when a step-acquisition occurs in a simple group structure.

CONCLUSION

This paper demonstrates teaching practices that use principles of cognitive psychology to enhance student learning of a number of critical accounting concepts. By implementing these principles in the classroom educators will facilitate the learning process of their students. It is advocated that faculty consider applying these principles in their teaching. Faculty are experts in their fields and thus they have hierarchical and integrated knowledge frameworks (Mestre, Dufresne, Gerace, & Hardiman, 1993) to develop the cues necessary to aid students in the knowledge transfer process.

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APPENDICES

Table 1
Suggested bond amortization schedule for either a premium or a discount.

A	B	C	D	E	F
Date	Beginning bond balance	Interest expense	Interest payment	Amortization of premium or discount	Ending bond balance
		Column B * effective interest rate * period	Maturity value * stated interest rate * period	Column C – Column D	Column B + Column E

Table 2
Traditional weighted average cost method.

	Number of units	Cost
Beginning inventory	X	X
Net purchases	X	X
Available-for-sale (AFS)	XXX	XXX
Units sold/Cost of goods sold	(X)	Units sold * WAC
Ending inventory (EI)	XXX	EI units * WAC

Net purchases include purchase returns.
Weighted average cost (WAC) = AFS cost/AFS units.
The lower of cost or market (LCM) evaluation results in a separate entry for the write-down.

Table 3
Retail inventory method using the weighted average cost estimate.

	Cost ($)	Retail ($)
Beginning inventory	20,000	36,000
Net purchases	60,000	120,000
Net markups		7,000
Net markdowns		(3,000)
Available-for-sale (AFS)	80,000	160,000
Cost of goods sold/Net sales	(55,000) balancing figure	(110,000)
Ending inventory (EI)	25,000	50,000

		(Retail EI * CRR or 50,000*0.5)

Cost-to-retail ratio (CRR) = AFS cost/AFS retail or 0.50 ($80,000/$160,000).
Net purchases include purchase returns.
Net sales include employee discounts and sales returns.

Table 4
Suggested method using the weighted average cost estimate.

	Retail ($)	Cost ($)
Beginning inventory	36,000	20,000
Net purchases	120,000	60,000
Net markups	7,000	
Net markdowns	(3,000)	
Available-for-sale (AFS)	160,000	80,000
Net sales/Cost of goods sold	(110,000)	(55,000) balancing figure
Ending inventory (EI)	50,000	25,000 (Retail EI * CRR or 50,000*0.5)

Cost-to-retail ratio (CRR) = AFS cost/AFS retail or 0.50 ($80,000/$160,000).
Net purchases include purchase returns.
Net sales include employee discounts and sales returns.

Table 5
The retail inventory method using the conventional weighted average cost estimate.

	Cost ($)	Retail ($)
Beginning inventory	20,000	36,000
Net purchases	60,000	120,000
Net markups		7,000
Sub-total	80,000	163,000
Net markdowns		(3,000)
Cost of goods sold/Net sales	(55,460) balancing figure	(110,000)
Ending inventory (EI)	24,540 (Retail EI * CRR or 50,000*0.4908)	50,000

Cost-to-retail ratio (CRR) = Sub-total cost/Sub-total retail or 0.4908 ($80,000/$163,000).
Net purchases include purchase returns.
Net sales include employee discounts and sales returns.

Table 6
Suggested method using the conventional weighted average cost estimate.

	Retail ($)	Cost ($)
Beginning inventory	36,000	20,000
Net purchases	120,000	60,000
Net markups	7,000	

	Retail	Cost
Net markdowns	(3,000)	
Available-for-sale (AFS)	160,000	80,000
Net sales/Cost of goods sold	(110,000)	(55,460) balancing figure
Ending inventory (EI)	50,000	24,540 (Retail EI * LCMRR or 50,000*0.4908)

LCM-to-retail ratio (LCMRR) = AFS cost/ (AFS retail + net markdowns) or 0.4908 ($80,000/$163,000).
Net purchases include purchase returns.
Net sales include employee discounts and sales returns.

APPENDIX 1

Suggested method for the retail inventory method using LIFO estimates.

	Retail	Cost	Sales at retail	Cost of goods sold
Beginning inventory	$ 36,000	$ 20,000		Layer retail sales * layer CRR
Net purchases	124,000	60,000	(110,000)	(53,226) Layer retail sales * layer CRR or [(110,000)* 0.4839 (60,000/124,000)]
Available-for-sale (AFS)	160,000	80,000	(110,000)	(53,226)
Net sales/Cost of goods sold	(110,000)	(53,226)		
Ending inventory	50,000	26,774		

Layer CRR = layer cost/layer retail.
Retail net purchases include markups and markdowns.
Net purchases include purchase returns.
Net sales include employee discounts and sales returns.
The process of allocating the available-for-sale cost between cost of goods sold and ending inventory requires the determination of the applicable layers to which net sales must be allocated. This is done by setting up a column for the allocation of the total net sales (step 1). Step 2 allocates the net sales to the applicable layers using the LIFO basis. Finally the total cost of goods sold is determined by computing the cost of goods sold for each layer and summing the layers (step 3).

APPENDIX 2

Suggested method for the retail inventory method using FIFO estimates.

	Retail	Cost	Sales at retail	Cost of goods sold
Beginning inventory	$ 36,000	$ 20,000	(36,000)	(20,000) Layer retail sales * layer CRR or [(36,000)* 0.5556 (20,000/36,000)]

Net purchases	124,000	60,000	(74,000)	(35,806)Layer retail sales * layer CRR or [(74,000)* 0.4839 (60,000/124,000)]
Available-for-sale (AFS)	160,000	80,000	(110,000)	(55,806)
Net sales/Cost of goods sold	(110,000)	(55,806)		
Ending inventory	50,000	24,194		

Layer CRR = layer cost/layer retail.
Retail net purchases include markups and markdowns.
Net purchases include purchase returns.
Net sales include employee discounts and sales returns.
The process of allocating the available-for-sale cost between cost of goods sold and ending inventory requires the determination of the applicable layers to which net sales must be allocated. This is done by setting up a column for the allocation of the total net sales (step 1). Step 2 allocates the net sales to the applicable layers using the FIFO basis. Finally the total cost of goods sold is determined by computing the cost of goods sold for each layer and summing the layers (step 3).