Using Mathematics to Teach Accounting Principles

SONY WARSONO
Universitas Gadjah Mada

Abstract: *As widely acknowledged, Luca Pacioli discussed accounting in his mathematics book Summa de Arithmetica, Geometria, Proportioni et Proportionalita. Using the perspective of mathematics, this paper shows that the majority of available accounting principles literature employs accounting equations positioning the elements of both assets and expenses in opposite accounting equations, rather than placing the two elements in the same side of the accounting equation. More than just offering consistent rationality, the use of mathematics rationality will make it much simpler to explain why the elements of assets and expenses should receive the same treatment concerning debits and credits. Furthermore, this paper shows that the rules of debits and credits are entirely based on mathematical logic. Finally, this paper proposes the need for learning to account from the perspective of mathematics, in addition to those of GAAP and engineering skills.*

Keywords: *Accounting education methods; definition of equity; expanded accounting equations; mathematics rationality; rules of debits and credits; mathematics-oriented study of accounting principles*

Abstrak: *Sebagaimana diakui secara luas, Luca Pacioli membahas akuntansi dalam buku matematikanya Summa de Arithmetica, Geometria, Proportioni et Proportionalita. Dengan menggunakan perspektif matematika, makalah ini menunjukkan bahwa sebagian besar prinsip akuntansi akuntansi yang tersedia menggunakan persamaan akuntansi yang memposisikan unsur-unsur dari kedua aset dan biaya dalam persamaan akuntansi yang berlawanan, daripada menempatkan dua elemen di sisi yang sama dari persamaan akuntansi. Lebih dari sekadar menawarkan rasionalitas yang konsisten, penggunaan rasionalitas matematika akan membuatnya lebih mudah untuk menjelaskan mengapa unsur-unsur aset dan pengeluaran harus menerima perlakuan yang sama mengenai debet dan kredit. Selanjutnya, tulisan ini menunjukkan bahwa aturan debit dan kredit sepenuhnya didasarkan pada logika matematika. Akhirnya, makalah ini mengusulkan perlunya belajar untuk memperhitungkan dari perspektif matematika, selain dari GAAP dan keterampilan teknik.*

Kata Kunci: *Metode pendidikan akuntansi; definisi ekuitas; persamaan akuntansi yang diperluas; rasionalitas matematika; aturan debit dan kredit; studi berorientasi matematika dari prinsip-prinsip akuntansi*

---

* Corresponding author: swarsono@ugm.ac.id

1. Introduction

A large number of accounting software generate information which is reliable and relevant, comply with generally accepted accounting principles (GAAP), and fulfill the various needs for corporate financial information. The development of the accounting software must have involved many professionals other than accountants, including programmers who are used to mathematical thinking. These programmers can understand the workings of accounting even without having to study it in detail. Accordingly, there must be some methods which can be employed to teach accounting principles at the college level to supplement the current teaching because the latter has been questioned regarding its effectiveness due to some inappropriateness in the methods of learning accounting principles. This paper employs the perspective of mathematics in solving crucial issues which typically come to the surface in class discussions about accounting principles.

Discussions about accounting principles teaching methods are always appealing. The traditional teaching of accounting has been criticized in many countries (Duff and McKinstry 2007) because they are considered either too narrow procedural (Patten & Williams 1990; Nelson 1995) or unable to catch up with current development in business to the extent that students can hardly receive any perfect picture of the real business world (Adler 1999).

A number of experts have questioned the importance of teaching of debits and credits in classes of accounting principles because it is considered too mechanical, unintuitive, and forcing the student to rely on memory only (Ingram 1998), and susceptible of providing an incorrect picture about accounting to students who do not major in accounting (Pincus 1997; Diller-Hass 2004). Furthermore, the double-entry system in accounting has experienced a significant decrease in relevance with the advent of software which is capable of providing a variety of information without having to set up general ledgers (Elam 1995 in Pincus 1997). On the other hand, a number of other experts have tried to maintain the teaching of debits and credits in accounting principles because debits and credits are believed to be "part of the vocabulary in our language"

(Wallace 1997, 230), and because debits and credits are an indispensable part in the learning process of accounting (Vangermeersch 1997).

A great number of experts have been discussing the need for changes in the teaching methods of accounting (Rankin et al. 2003; Hartnett et al. 2004). Albrecht and Sack (2000) stated that the study of accounting needs to be modified to catch up with changes in technology and globalization. Saudagaran (1996) and Springer and Borthick (2004) noted that the traditional curriculum of accounting, which emphasizes memorizing skills, may actually hinder the student's effort to develop the requisite competencies in accounting, such as critical thinking. The AECC has suggested the needs for restructuring accounting principles through learning by using a user model instead of a preparer model (in Lee and Bisman 2006). The user model was perceived to be able to provide the student with a better understanding of the concept of accounting (Baldwin and Ingram 1991; Bernardi and Bean 1999). Other researchers suggested the use of information technology to improve the effectiveness of accounting study (Elliot, 1992; Pincus 1997; Mohamed and Lashine 2003; David et al. 2003; Goldwater and Fogarty 2007).

Even though the business has experienced dynamic changes, the study of accounting remains essentially the same (Albrecht and Sack 2000; Sangster, et al. 2007), passive (Bonner 1999; Boyce et al. 2001), procedural (Dempsey and Stegmann 2001), inadequate in equipping the student with the necessary competencies (Mohamed and Lashine 2003), and relying merely on a one-way direction of knowledge distribution (Williams 1993; Saunders and Christopher, 2003). This traditional learning of accounting makes accounting books look similar to one another (Sullivan and Benke 1997) which in turn make accounting less than appealing to the student. For the next ten years, there will be a shortage of faculty members with Ph.D.'s (AACSB 2003). The shortage of American lecturers and doctorate students in accounting "already exists and may grow" (Plumlee et al. 2006, 113). Fogarty and Markarian (2007) indicate that there has been a decrease in the number of accounting lecturers – one that may escalate to a serious problem of sustainability for the discipline of accounting. Furthermore, there is

an increasing number of students who decide to major in accounting after enrolling in a university (Nelson et al. 2008).

The Teaching and Curriculum Section of the American Accounting Association states that research into the history of accounting may provide a precious lesson to comprehend the discipline of accounting (in Sangster et al. 2007). In line with this idea, this paper employs the perspective of mathematics to discuss essential topics in accounting principles. As widely acknowledged, Luca Pacioli is a university professor of mathematics who discusses accounting in his book *Summa de Arithmetica, Geometria, Proportioni et Proportionalita* (Sangster et al. 2007). Using the perspective of mathematics, this paper presents solutions which would make the goal of learning accounting attainable, that is, by introducing the student to the fact that accounting is, in reality, a much appealing knowledge that would encourage the student to try to find out more about it.

Actually, the mathematical perspective has been employed in some accounting books, but it is seldom mentioned explicitly, and sometimes it is used inconsistently. From some observations on the majority of literature on accounting principles, the present paper concludes that only a few books state with enough emphasis that accounting is one of the sciences that based on mathematics. This paper also concludes that the majority of available literature employs accounting equations positioning the elements of both assets and expenses in opposite accounting equations, rather than placing the two elements in the same side of the accounting equation, even though both equations are mathematically correct. Furthermore, this paper shows that the rules of debits and credits are entirely based on mathematical logic. Finally, this paper discusses the need for learning to account from the perspective of mathematics, in addition to those of GAAP and engineering skills.

The Definition of Equity

Accounting is based on the basic equation that assets equal to liabilities plus equity. Equity is a residual interest, namely the arithmetic difference between assets and liabilities (Alfredson et al. 2007). This definition of equity is intended to maintain a

balance between the left side and the right side of the accounting equation. However, most books of accounting principles simplify the definition of equity as "owner's equity," which reflects the owner's claim over the firm. The use of the term "owner's equity" narrows the real meaning of equity. In general, primarily at the formation of a firm, the element of equity is likely to be the owner's investment. Under certain circumstances, however, equity may come from grants, donations, or aids from the government or other outside parties which may not be categorized as owners. In other words, the use of the term "owner's equity" is very likely to raise a dilemma: that the balance in the accounting equation cannot always be attained due to the reception of grants, donations, or government aids which do not meet the criteria either liabilities or owner's equity. Of course accounting teachers have their own ready answers to this dilemma, but should they give any advanced answers to simple questions posed by accounting novices?

Some textbooks provide an additional description of owner's equity as a residual value so that assets always equal the total amount of liabilities and owner's equity (Horngren et al. 2002; Williams et al. 2005; Anthony et al. 2007; Weygandt et al. 2008). FASB and IASB define equity or net assets as "the residual interest in the assets of an entity that remains after deducting all its liabilities" (FASB 1985, par. 49; IASB Technical Summary 2008). Thus, both standards emphasize that equity is merely a mathematical rule intended to maintain a balance in the accounting equation. Therefore, it is appropriate to use the terms equity, net assets, or residual interest of assets in the study of accounting principles, instead of the term "owner's equity" commonly used in accounting principles textbooks.

The Rationality of Accounting Equations

Assets are resources under the firm's control, whose funds come from liabilities and equity (sources of funds). Accounting conveys the elements of revenues, expenses, and dividends in the accounting equation (called the expanded accounting equation) because the firm conducts business and distributes dividends. The three elements are part of equity; revenues increase equity, while expenses and dividends decrease equity.

That is the rationality of the accounting equation employed in most accounting textbooks. The rationality is primarily based on the balance-sheet approach so that other accounting variables (including revenues and expenses) are "considered secondary and derivative" (Dichev 2008, 454). The emphasis on the balance-sheet approach is "unclear" (Dichev 2008) and "requires revaluations that often are not trustworthy" (AAA's Financial Accounting Standards Committee 2007).

The basic accounting equation can be expressed as equation 1 (see Figure 1), and the expanded accounting equation can be expressed as equation 2 (see Figure 2).

Many textbooks employ the basic accounting equation (equation 1) to analyze transactions which result in changes in the element of revenues, expenses and dividends (Ainsworth et al. 2000; King et al. 2001; Porter and Norton 2001; Warren et al. 2002; Libby et al. 2004; Williams et al. 2005; Anthony et al. 2007). Several of these textbooks write down the expanded accounting equation (equation 2) in their books (Horngren et al. 2002; Weygandt et al. 2008).

Is there any rationality inappropriateness in the existing textbooks in their explanations of the accounting equation? Although the expanded accounting equation (equation 2) is mathematically correct, the rationality which applies to equation 1 is applied inconsistently to equation 2 because the elements of expenses and dividends are not sources of funds. In other words, the rationality employed to explain basic accounting equation is different from that employed to explain the expanded accounting equation. Learning which employs different rationalities to explain two things which in essence are closely related is liable to confuse students.

Ingram (1998) employs equation 3 (see Figure 3) to simplify the understanding of the logic of debits and credits. However, it is hard to find textbooks which express the accounting equation as shown in equation 3 although mathematically equation 2 and equation 3 are both correct. Therefore, it is interesting to find the rationality of the accounting equation expressed in equation 3 because mathematically it is more proper to place elements with the same signs (positive or negative) on the same side. For the sake of simplicity, this paper calls the rationality of equation 3 as mathematical rationality, while this paper calls the rationality of equation 2 as conventional rationality.

Subramanyam and Wild (2009) and Anthony et al. (2007) state that the basic accounting equation can be perceived as sources and uses of the fund. Therefore, by using the mathematical rationality, the left side of equation 3 reflects the uses of the fund, while the right side reflects the sources of fund. The company uses the funds to acquire assets, pay expenses and/or distribute dividends with funds taken from the sources of liabilities, equity, and/or revenues. This mathematical rationality can consistently explain both the basic accounting equation (equation 1) and the expanded accounting equation (equation 3).

Vangermeersch (1997) noted that revenues and expenses are separate elements and not subdivisions of equity. Therefore, the placement of revenues, expenses, and dividends on the same side (equation 2) is a compulsion that runs the risk of confusing the student. Besides raising the problem of inconsistency in the rationality of the accounting equation, two additional reasons make the use of equation 2 unacceptable. First, by definition equity is limited to a residual interest or net assets to the effect that there is no appropriate justification for an explanation as to why the element of revenues, expenses, and dividends should belong to equity. Secondly, the attachment of one element to the other may result in their being less than optimal. Analogizing the approaches of data management in the computer system, the database approach provides information which is more up-to-date, standardized, and easier to access than the application-oriented approach because the database approaches separate data from their application software (Romney and Steinhart 2009).

More than just offering consistent rationality, the use of equation 3 will make it much simpler to explain why the elements of assets and expenses should receive the same treatment in relation to debits and credits even though by definition assets and expenses markedly differ from one another; assets represent sources which provide future benefit, while expenses represent a sacrifice of assets (FASB 1985). Moreover, the use of equation 1 or 2 forces the student to think twice when identifying changes in the accounts due to expense transactions and dividend transactions; the recognition of expenses (dividends) make expense (dividend) accounts increase, but must be recorded as a decrease because expenses (dividends) decrease equity. This is an unnecessary step

and is liable to raise confusion to the student especially when he or she should identify accounts which must be debited or credited). Unlike equation 1 or 2, the use of equation 3 dispenses with this unnecessary step and minimizes confusion in the student's mind when identifying debit or credit accounts.

The Rules of Debits and Credits

Experts have much debated the rules of debits and credits. In their consideration, the mechanism of debits and credits does not make sense ("debits and credits are nothing more than pluses and minuses", Ingram 1998, 411), demands the student simply to memorize (Pincus 1997), is too narrowly procedural (Patten and Williams 1990; Nelson 1995), and is liable to convey a mistaken picture about accounting to the student (Pincus 1997; Diller-Haas 2004). As far as we know, all accounting textbooks discuss these rules of debits and credits. Some textbooks state that the rules of debits and credits are arbitrary (Anthony et al. 2007), a rule of thumb (Williams et al. 2007), or customs "like the custom of driving on the right-hand side…" (Weygant et al. 2008, 49). Other textbooks briefly describe these rules by providing mathematical illustrations expected to facilitate the student's understanding (Ainsworth et al. 2000). Nevertheless, the description ends up with an appeal that the student memorizes merely the rules (Walther 2009).

From the mathematical perspective, this debit and credit mechanism actually has an argument which is very clear and easily understandable to the student. In essence, this debit and credit mechanism represents a consequence of the accounting equation whose recording is reflected in the double-entry system.

Why should the asset accounts be debited when they increased and credited when they decrease? We can get an answer to that question by taking a close look at the following figures and its two illustrative cases.

Figure 4 indicates the position of each element in the accounting equation: assets, expenses, and dividends on the left (debit) side of the equation, while liabilities, equity, and revenues on the right (credit) side.

Case A (see Figure 5): Suppose Company A purchases supplies on account. This transaction engenders changes in the Supplies account and the Account payable account; both accounts increase. The Supplies account is recorded on the debit side, while the Account payable account is recorded on the credit side. This is in line with the position of each account in the accounting equation

Case B (see Figure 6): Suppose Company A purchases supplies in cash. This transaction engenders changes in the Supplies account and the Cash account; the Supplies account increases, while the Cash account decreases. In this case, both accounts are assets. To maintain internal consistency mathematically, the Supplies account must be debited because the supplies account is an element of assets; assets have positive values, and are on the left (debit) side of the accounting equation. Next, following mathematical rules, the Cash account must be credited because of a decrease in cash as a result of the transaction.

Case C (see Figure 7): Suppose Company A converts its notes payable into bonds. This transaction engenders changes in the Notes payable account and the Bonds payable account; the Bonds payable account increases, while the Notes payable account decreases. In this case, both accounts are liabilities. To maintain internal consistency mathematically, the Bonds payable account must be credited because the bonds payable account is an element of liabilities; liabilities have positive values, and are on the right (credit) side of the accounting equation. Next, following mathematical rules, the Notes payable account must be debited because of a decrease in notes payable as a result of the transaction.

Analogizing the transactions in Case B and C, we establish the rules of debits and credits for other elements of the expanded accounting equation. This rule has been in force in accounting now. Therefore, the debit and credit rule is based on a mechanism which entirely follows the mathematical logic. In our experience, students can understand and accept this debit and credit rule more easily than if they have to memorize it. In other words, the use of the mathematical perspective has made irrelevant the assumption that the debit and credit rule is something that should be memorized.

With good reasoning, students may find it easier to apply the debit and credit rule to all kinds of algebraic equations, not just concerning the accounting equation.

It is true that the debit and credit rule is essentially mechanical. Is it relevant, then, that this debit and credit rule be taught in classes of accounting principles? It is still relevant. First, the debit and credit rule convey a picture to the student that accounting is based on established knowledge, especially mathematics. Second, as computer science with its binary digits (0 and 1) and the science of electricity with its "on" and "off," accounting is endowed with debits and credits as a unique knowledge, which is used only in accounting. Third, debits and credits can be used to enhance the concreteness of knowledge of accounting; the study of debits and credits tangibilizes the workings of accounting. Tangibilizing accounting mechanism is essential to help the student understand accounting topics related to keeping journals, posting, which are indeed in the heart of accounting as an academic discipline. Fourth, as accounting students are expected to compile or construct information, not just to use information, they must have acquired basic knowledge of data processing into some useful information (Vangermeersch, 1997). Fifth, knowledge of debits and credits encourages the student to think systematically and logically and to develop the knowledge about accounting dynamics as a fast-growing science through the implementation of mathematical knowledge.

The use of The Worksheet

Learning about the worksheet is one of the important topics discussed in textbooks about accounting principles because it can give a clear picture of the process of compiling financial statements. The worksheet format can be designed in a variety of ways as long as it helps in the compilation of financial statements. The 10-column worksheet format is one of the numerous worksheet formats that for a long time had been in common use in accounting textbooks (Porter and Norton 2001; Williams et al. 2005; Weygandt et al. 2008). Walther (2009) discusses the use of the 12-column worksheet (one with 10 columns plus 2 additional columns for statements of retained earnings).

The use of the 10-column format, as well as the 12-column one, reflects the application of mathematics in accounting. Nevertheless, there are "tricks" in the recording of net income in the Net income column and the Balance sheet column in the worksheet. When the firm gets profits, the amount of the monetary profits is recorded on the left side of the Net Income column (to maintain balance between the debit and credit sides of the Net Income column), but then must be recorded on the credit side of the Balance sheet column, or the other way around when the company undergoes losses. This rule indicates inconsistency in the mathematical application, which is liable to confuse the student (see Table 1).

One way among many that can be employed to dispense with this inconsistency is the use of a 12-column worksheet, consisting of a 10-column worksheet plus 2 columns for closing entries. In addition to its usefulness to dispense with the inconsistency of the 10-column worksheet, the 12-column worksheet is also useful for the study of accounting. Firstly, the provision of the 2 columns for the closing entries indicates that closing entries are among the essential activities in accounting (without which the balance of nominal accounts would be carried to the next period). Secondly, the 12-column worksheet engenders the Income Summary account, which comes out due to the existence of the closing entries. This Income Summary account is important to show the firm's profit or loss. Thirdly, the 12-column worksheet conveys the up-to-date balance of the retained earnings account so that the Balance sheet column in the worksheet helps a lot in compiling the financial statements (see Table 2).

Mathematics-Oriented Study of Accounting Principles

There are still many important topics about the accounting principles that can be explained mathematically. Our experience indicates that when told that the primary working of accounting is based on mathematics, the student can understand accounting topics more easily, including adjusting entries –whose debits and credits have often become an object of complaint on the part of the students (Pincus 1997) – and the crucial problem of closing entries.

Accounting is a tool to attain a particular aim (Ingram 1998). In other words, accounting should be treated like technology. As a technology, accounting can be made analogous to aircraft, computers, or any other technological products. Those technologies are developed systematically, logically, and from sciences whose validity has been so well established that they are capable of growing even further and giving a vast contribution to the humankind.

We argue that the development of accounting is affected by three interrelated pillars:

a. Mathematics; this pillar should be firmly founded upon which accounting may grow.

b. Generally accepted accounting principles (GAAP); this pillar serves to ensure that the development of accounting could be well understood and accepted by the users.

c. Engineering skills; this pillar provides a space for the user for developing the kind of accounting that is most suitable to his wants and needs.

The development of accounting should be done through the development of the three pillars mentioned above.

The tremendous growth of the business world has likewise increased the complexities of accounting and financial reporting. Up to now the development of accounting (GAAP) regulations has been intensively done with the hope that such a development may provide the necessary solutions to existing problems. Nevertheless, "we cannot expect regulation to protect investors" (Scott 2009, 15) completely. Therefore, it is expected that a development that gives preeminence to the mathematical pillar would enable accounting to provide a significant contribution to mankind.

The addition of the revenues and expenses elements would make accounting study dynamic (Vangermeersch 1997). By using the mathematical perspective, it is expected that accounting study would be more dynamic and capable of inviting the student to develop accounting knowledge, rather than to be content with understanding accounting simply as a rule of play established by the business game. The use of the mathematical perspective can also be an initial step toward the development of new

models of determining monetary values in financial statements, which up to now have been considered within the competence of other fields.

Conclusion

Historically, accounting was based on mathematical knowledge as codified in Luca Pacioli's book of mathematics. Using the mathematical perspective, the present paper reviews several basic issues in textbooks of accounting principles commonly employed so far and presents rationality based on clear arguments over the rules of debits and credits. By designing mathematics-oriented learning, it is expected that the study of accounting principles would be dynamic and capable of developing the capacities for inquiry, abstract logical thinking, and critical analysis (AECC 1990).

The development of the mathematical pillar in accounting would enable it to develop faster rather than remaining just a tool to provide information as it essentially is right now. As a result, the way is open wide for the addition of the elements of accounting equations as well as new accounting topics developed mathematically.

References

AAA's Financial Accounting Standards Committee: Benston, G.J., D.R. Carmichael, J.S. Demski, B.G. Dharan, K.Jamal, R. Laux, S. Rajgopal, and G. Vrana. 2007. The FASB's conceptual framework for financial reporting: A critical analysis. *Accounting Horizons* Vol. 21, No.2: 229–238.

AACSB (Association for the Advancement of Collegiate Schools of Business), International. 2003. *Report of the Doctoral Faculty Commission to AACSB International's Board of Directors*. Tampa Florida.

Adler, R. W. 1999. Five ideas designed to rile everyone who cares about accounting education. *Accounting Education: An International Journal* Vol 8, No.3: 241–247.

AECC (Accounting Education Change Commission). 1990. Objectives of education for accountants: Position Statement Number One. *Issues in Accounting Education* Vol 5, No. 4: 307–312.

Ainsworth, P., D. Deines, R. D. Plumlee, and C. X. Larson. 2000. *Introduction to Accounting: An Integrated Approach*. Volume 1 Chapters 1 – 13, Second Edition. International edition. McGraw-Hill.

Albrecht, W. S. and R. J. Sack. 2000. Accounting education: Charting the course through a perilous future. *Accounting Education Series* Vol. No. 16. Florida: American Accounting Association.

Alfredson, K., K. Leo, R. Picker, P. Pacter, J. Radford, and V. Wise. 2007. *Applying International Financial Reporting Standards: Enhanced Edition.* Milton, Queensland: John Wiley & Sons Australia Ltd.

Anthony, R. N., D. F. Hawkins, and K. A. Merchant. 2007. *Accounting: Text and Cases*. Twelfth edition. International edition. McGraw-Hill.

Baldwin, B. A. and R. W. Ingram. 1991. Rethinking the objectives and content of elementary accounting, *Journal of Accounting Education* Vol. 9, No.1: 1–14.

Bernardi, R. A. and D. F. Bean. 1999. Preparer versus user introductory sequence: The impact on performance in Intermediate Accounting I, *Journal of Accounting Education* Vol. 17: 141–156.

Bonner, S. E. 1999. Choosing teaching methods based on learning objectives: An integrative framework, *Issues in Accounting Education* Vol. 14 No. 1: 11– 40.

Boyce, G., S. Williams, A. Kelly and H. Yee. 2001, Fostering deep and elaborative learning and generic (soft) skill development: The strategic use of case studies in accounting education, *Accounting Education: An International Journal* Vol. 10, No. 1: 37–60.

David, J. S., H. MacCracken, and P. M. Reckers. 2003. Integrating technology and business process analysis into introductory accounting courses. *Issues in Accounting Education* Vol. 18, No. 4: 417–425.

Dempsey, A. and N. Stegmann. 2001. Research on Accounting I – Attracting and retaining learners. Viewed 31 March 2009: *https://www.saica.co.za/documents/ Accounting%201.pdf*.

Dichev, I. D. 2008. On the balance sheet-based model of financial reporting. *Accounting Horizons* Vol. 22, No. 4: 453–470.

Diller-Haas, A. 2004. Time to change introductory accounting. *The CPA Journal* Vol. LXXIV, No. 4: 60–62.

Duff, A. and S. McKinstry. 2007. Students' approaches to learning. *Issues in Accounting Education* Vol. 22, No. 2: 183–214.

Elliott, R. K. 1992. The Third Wave Breaks on the Shores of Accounting. *Accounting Horizons* Vol. 6, No. 2: 61–85.

FASB. 1985. *Statement of Financial Accounting Concepts No. 6: Elements of Financial Statements*. Financial Accounting Standards Board: Norwalk, Connecticut.

Fogarty, T., and G. Markarian. 2007. An empirical assessment of the rise and fall of accounting as an academic discipline. *Issues in Accounting Education* Vol. 22, No. 2: 137–161.

Goldwater, P. M., and T. J. Fogarty. 2007. Protecting the solution: A 'high-tech.' method to guarantee individual effort in accounting classes. *Accounting Education* Vol. 16, No. 2: 129–143.

Hartnett, N., J. Romcke, and C. Yap. 2004. Student performance in tertiary-level accounting: An international student focus, *Accounting & Finance* Vol. 44, No.2: 163–185.

Horngren, C. T., G. L. Sundem, and J. A. Elliott. 2002. *Introduction to Financial Accounting*. Eighth Edition. Upper Saddle River, New Jersey. Prentice Hall.

Hwang, N. R., G. Lui, and M. Y. J. W. Tong. 2005. An empirical test of cooperative learning in a passive learning environment. *Issues in Accounting Education* Vol. 20, No. 2: 151–165.

IASB Technical Summary. 2008. *Framework for the Preparation and Presentation of Financial Statements.* Viewed 5 March 2009: http://www.iasb.org/NR/rdonlyres/E29DA762-C0E1-40F8-BDD4-A0C6B5548B81/0/Framework.pdf

Ingram, R. W. 1998. A note on teaching debits and credits in elementary accounting. *Issues in Accounting Education* Vol. 13, No. 2: 411–415.

King, T. E., V. C. Lembke, and J.H. Smith. 2001. *Financial Accounting: a Decision-making Approach*. Second Edition. US. John Wiley & Sons, Inc.

Lee, C. and J. E. Bisman. 2006. Curricula in introductory accounting: The 'old' and the 'new'. Paper presented at the Accounting & Finance Association of Australia & New Zealand Annual Conference, July, Wellington, New Zealand. Viewed 20 March 2009: http*://www.afaanz.org/research/AFAANZ%2006117.pdf*.

Libby, R., P. A. Libby, and D. G. Short. 2004. *Financial Accounting*. Fourth Edition. International Edition. McGraw-Hill.

Mohamed, E. K. A., and S. H. Lashine. 2003. Accounting knowledge and skills and the challenges of a global business environment. *Managerial Finance* Vol. 29, No. 7: 3–16.

Nelson, I. T. 1995. What's new about accounting education change? A historical perspective on the change movement. *Accounting Horizons* Vol. 9, No. 4: 62 – 75.

Nelson, I. T., V. P. Vendrzyk, J. J. Quirin, and S. E. Kovar. 2008. Trends in accounting student characteristics: Results from a 15-year longitudinal study at FSA schools. *Issues in Accounting Education* Vol. 23, No. 3: 373–389.

Patten, R. J. and D. Z. Williams. 1990. There's trouble – right here in our accounting programs: The challenge to accounting educators. *Issues in Accounting Education* Vol. 5, No. 2: 175–179.

Pincus, K. V. 1997. Is teaching debits and credits essential in elementary accounting? *Issues in Accounting Education* Vol. 12, No. 2: 575–579.

Plumlee, R., S. Kachelmeier, S. Madeo, J. Pratt, and G. Krull. 2006. Assessing the shortage of accounting faculty. *Issues in Accounting Education* Vol 21, No. 2: 113–125.

Porter, G. A. and C. L. Norton. *Financial Accounting: The impact on decision makers*. Third Edition. USA. Harcourt College Publishers.

Rankin, M., M. Silvester, M. Vallely, and A. Wyatt. 2003. An analysis of the implications of diversity for students' first level accounting performance. *Accounting and Finance* Vol. 43: 365–393.

Romney, M. B., and P. J. Steinbart. 2009. *Accounting Information Systems*. Eleventh Edition. Prentice Hall.

Sangster, A., G. N. Stoner, and P. A. McCarthy. 2007. Lessons for the classroom from Luca Pacioli. *Issues in Accounting Education* Vol. 22, No. 3: 447–457.

Saudagaran, S. M. 1996. The first course in accounting: An innovative approach, *Issues in Accounting Education* Vol. 11, No. 1: 83–94.

Saunders, G. and J. E. R. Christopher. 2003. Teaching outside the box: A look at the use of some nontraditional teaching models in accounting principles courses. *Journal of American Academy of Business* Vol. 3, No. 1 & 2: 162–165.

Scott, W. R. 2009. *Financial Accounting Theory*. Fifth Edition. Canada. Pearson Education.

Springer, C. W., and A. F. Borthick. 2004. Business simulation to stage critical thinking in introductory accounting: Rationale, design, and implementation. *Issues in Accounting Education* Vol. 19, No. 3: 277–303.

Subramanyam, K. R., and J. J. Wild. 2009. *Financial Statement Analysis*. Tenth Edition. International edition. McGraw-Hill/Irwin.

Sullivan, M. C., and R. L. Benke. 1997. Comparing introductory financial accounting textbooks. *Journal of Accounting Education* Vol. 15, No.2: 181–220.

Vangermeersch, R. G. 1997. Dropping debit and credits in elementary accounting: A huge disservice to students. *Issues in Accounting Education* Vol. 12, No. 2: 581–583.

Wallace, W. A. 1997. Where are the debits and credits? Editor's perspective. *Issues in Accounting Education* Vol. 12, No. 1: 229–230.

Walther, L. 2009. *Principles of Accounting*. Viewed 17 March 2009: http://www.principlesofaccounting.com/

Warren, C. S., J. M. Reeve, and P. E. Fess. 2002. *Financial & Managerial Accounting*. Seventh Edition. USA. South-Western, a division of Thomson Learning.

Weygandt, J. J., D. E. Kieso, and P. D. Kimmel. 2008. *Accounting Principles*. Eighth Edition. John Wiley & Sons (Asia) Pte Ltd.

Williams, D. Z. 1993. Reforming accounting education. *Journal of Accountancy* Vol. 176 No. 2: 76–82.

Williams, J. R., S. F. Haka, and M. S. Bettner. 2005. *Financial & Managerial Accounting: The Basis for Business Decisions*. Thirteenth Edition. International edition. McGraw-Hill/Irwin.

Figure 1: Basic Accounting Equation

$$\text{Assets} = \text{Liabilities} + \text{Equity} \quad ....\text{equation 1}$$

Figure 2: Expanded Accounting Equation – Conventional Rationality

$$\text{Assets} = \text{Liabilities} + \text{Equity} + \text{Revenues} - \text{Expenses} - \text{Dividends} \quad ....\text{equation 2}$$

Figure 3: Expanded Accounting Equation – Mathematic Rationality

$$\text{Assets} + \text{Expenses} + \text{Dividends} = \text{Liabilities} + \text{Equity} + \text{Revenues} \quad ....\text{equation 3}$$

Figure 4: Position of Each Elements of Expanded Accounting Equation

(Dr)	ASSETS + EXPENSES + DIVIDENDS	=	LIABILITIES + EQUITY + REVENUES	(Cr)
	ASSETS (+)		**LIABILITIES** (+)	
	EXPENSES (+)		**EQUITY** (+)	
	DIVIDENDS (+)		**REVENUES** (+)	

Figure 5: Analysis of Transaction of Purchasing Supplies on Account

(Dr)	ASSETS + EXPENSES + DIVIDENDS	=	LIABILITIES + EQUITY + REVENUES	(Cr)
	Supplies (+) **(Increasing, debited)**		**Account payable** (+) **(Increasing, credited)**	

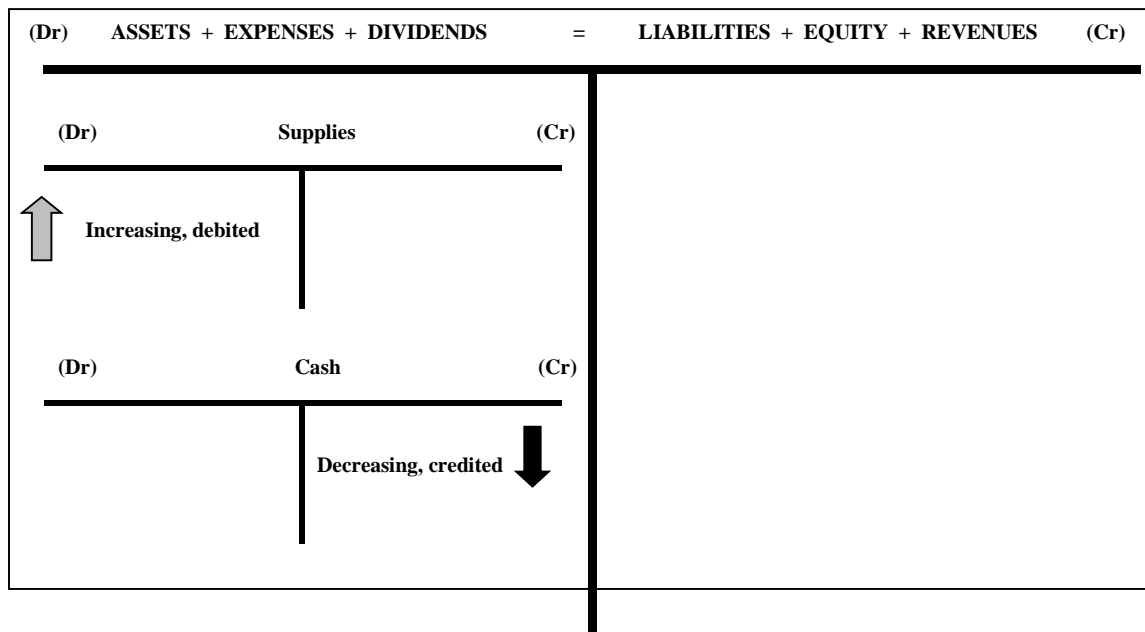Figure 6: Analysis of Transaction of Purchasing Supplies in Cash

(Dr) ASSETS + EXPENSES + DIVIDENDS	=	LIABILITIES + EQUITY + REVENUES (Cr)

(Dr) **Supplies** (Cr)

Increasing, debited ↑

(Dr) **Cash** (Cr)

Decreasing, credited ↓

Figure 7: Analysis of Transaction of Debt Conversion

(Dr) ASSETS + EXPENSES + DIVIDENDS	=	LIABILITIES + EQUITY + REVENUES (Cr)

(Dr) **Bonds Payable** (Cr)

Increasing, credited ↑

(Dr) **Notes Payable** (Cr)

↓ **Decreasing, credited**
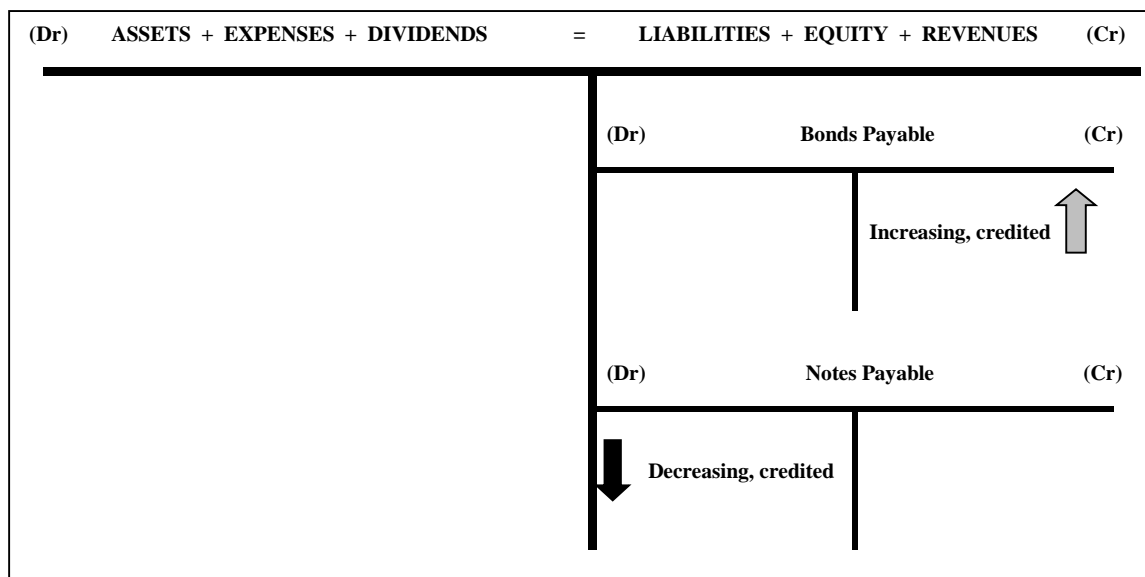
Table 1: The 10-Column Worksheet

ACCOUNTS	ADJUSTED TRIAL-BALANCE		NET INCOME		BALANCE SHEET	
	Debits	Credits	Debits	Credits	Debits	Credits
Assets	$200,000.00				$200,000.00	
Liabilities		$80,000.00				$80,000.00
Capital stock		$100,000.00				$100,000.00
Dividend	$7,000,00				$7,000.00	
Retained earnings		$15,000.00				$15,000.00
Revenues		$50,000.00		$50,000.00		
Expenses	$38,000.00		$38,000.00			
Net Income*			$12,000.00			$12,000.00
Total	$245,000.00	$245,000.00	$50,000.00	$50,000.00	$207,000.00	$207,000.00

*Net income is not an account.

Table 2: The 12-column worksheet (Including Closing entries)

ACCOUNTS	ADJUSTED TRIAL-BALANCE		NET INCOME		CLOSING ENTRIES		BALANCE SHEET	
	Debits	Credits	Debits	Credits	Debits	Credits	Debits	Credits
Assets	$200,000.00						$200,000.00	
Liabilities		$80,000.00						$80,000.00
Capital stock		$100,000.00						$100,000.00
Dividend	$7,000,00					d)$7,000.00		
Retained earnings		$15,000.00			d)$7,000.00	c)$12,000.00		$20,000**
Revenues		$50,000.00		$50,000.00	a)$50,000.00			
Expenses	$38,000.00		$38,000.00			b)$38,000.00		
Net Income*			$12,000.00					
Income summary***					b)$38,000.00 c)$12,000.00	a)$50,000.00		
Total	$245,000.00	$245,000.00	$50,000.00	$50,000.00			$200,000.00	$200,00.00

*Net income is not an account

**Ending balance of retained earnings is $20,000.00 (beginning balance of retained earnings + Net income – Dividends). The beginning balance of retained earnings is $15,000.00 as shown in the adjusted trial-balance column.

***Income summary is an important clearing account used to show the number of profit or loss.