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J. of Acc. Ed. 21 (2003) 239–260
Journal of Accounting Education
www.elsevier.com/locate/jaccedu

Teaching and educational notes

On the benefits of a mathematical solutions approach to time value of money instruction: arguments and evidence

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Received 1 April 2002; received in revised form 1 March 2003; accepted 1 April 2003

Abstract

This paper proposes several educational benefits to be derived by abandoning the traditional textbook focus on time value of money (TVM) tables and requiring student-generated mathematical solutions to TVM problems. These include: (1) greater reinforcement and appreciation for the theoretical concepts underlying TVM analysis; (2) improved professional preparation for dealing with real-life TVM applications; and (3) a better backdrop from which to introduce more sophisticated TVM topics calling for a requisite mathematical understanding (e.g., effective interest rates and exponential growth between discrete interest periods). Comparative computational efficiency and learning effectiveness are empirically evaluated in an experiment on two groups of students: those who reinforced their learning using a mathematical approach and those who reinforced their learning using tables. Students that employed the mathematical approach scored significantly higher on a common achievement test and also completed the tests in significantly less time. A post-experimental attitudinal questionnaire revealed statistically significantly stronger student preferences for the mathematical approach.

Keywords: Time value of money (TVM); Instruction; Pedagogy

1. Introduction

The time value of money (TVM) is central to the disciplines of accounting and finance. It also appears to be one of the more challenging topics for undergraduate

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0748-5751/03/$ - see front matter
doi:10.1016/S0748-5751(03)00023-X

business students, as gauged by tested comprehension. The typical business major receives two introductory exposures: the first in financial accounting when discussing long-term debt valuation (e.g., bonds and leases) and the second in managerial accounting when discussing capital budgeting models. Despite this previous coverage, however, anecdotal observation suggests that comprehension for many students remains low even after a third exposure in upper-level coursework that makes heavy use of discounting principles (e.g., intermediate accounting and corporate finance). Is the difficulty due to the subject matter itself, or is the conventional manner in which the subject is taught also partially to blame?

The argument presented in this paper is that the traditional pedagogy—namely, the use of tabulated TVM factors rather than student-generated mathematical solutions to TVM problems—*inherently* impedes understanding. Given that solutions manuals for accounting and finance texts rarely provide answers using mathematical formulations in lieu of, or at least in addition to, table references, it appears safe to conclude that a table focus is the typical focus. Importantly, this occurs for end-of-chapter assignments where TVM principles are reinforced and the majority of learning feedback is provided. Similarly, whereas financial calculator functions and spreadsheet software are becoming more prevalent in TVM instruction, there are important reasons for first grounding students solidly in the mathematical underpinnings of TVM.[1]

Prior to the microprocessor era, math texts devoted pages to tabulated values for square roots, logarithms, and trigonometric functions. Such table appendices today, however, are superfluous given that pocket calculators having these functions are readily affordable and widely-owned by students. Because calculator exponential functions are all that are required to solve TVM problems, the question of redundancy is also appropriately examined with respect to the publication of TVM factors as textbook appendices. Being pre-calculus concepts, exponential functions are well within most 4-year business programs' math prerequisites.[2] Consequently, if a *legitimate* reason exists for the continued use of tabulated factors in modern instruction, it is that they improve student learning (efficiency and/or effectiveness) over a mathematical approach that is made practicable by today's technology.[3]

The paper is organized along two objectives. First, several a priori arguments are made for drawing on students' prerequisite mathematical backgrounds when covering and reinforcing TVM concepts. Second, an empirical test of computational efficiency and learning effectiveness is reported for two experimental groups of

[1] The trend for computerized tools of analysis is evidenced by their increased coverage in modern textbooks. While this is appropriate given their computational efficiency and widespread use in practice, if computerized functions are taught solely for the purpose of computational expediency, students may fail to appreciate the underlying math well enough to modify their solution approaches for more complex TVM problems. This is addressed more fully below.

[2] Presumably math prerequisites for undergraduate business education are required for substantive reasons. If so, the issue of student timidity with respect to exponential algebra is not a justifiable reason for excluding such concepts from relevant areas of the business curriculum.

[3] A second reason for table usage may be at work that is not justified from the standpoint of good pedagogy. This is that instructors may be inclined to teach using the same (familiar) methods they were taught, without considering the risk of perpetuating an outdated or inferior approach.