

Introductory Accounting, with Matrices, at the Southern Federal University, Russia

Gregory N. Stoner and Anna Vysotskaya

ABSTRACT: Within the context of the globalization of the practice and profession of accounting, it is increasingly important that accounting faculty and students are aware of the international accounting environment. In addition, the continued growth in the cross-national flows of students increases the need for accounting faculty to be aware of international differences in the teaching and learning of accounting. This paper contributes to this arena by looking at the context, structure, and content of a successful introductory accounting course at a major university in the Russian Federation that uses matrix accounting theory in its introductory accounting course. By doing so, the paper provides accounting educators with a range of insights into the diversity of the international context of the teaching of accounting, and provides awareness of the theory of matrix accounting and how and why this mathematical approach to the teaching of introductory accounting has been adopted. In addition, as part of the important contextual background, the paper provides a rich description of the course, which could be used for comparison with other introductory accounting courses.

By looking at introductory accounting from a different perspective, the paper has the potential to help and encourage accounting faculty to think afresh about our discipline by questioning some of the taken-for-granted assumptions that underlie the approaches used in teaching accounting.

Keywords: introductory accounting; curriculum; international; Russia; matrix accounting theory; mathematics.

INTRODUCTION

This paper looks at the structure, approach, and teaching of an introductory accounting course in one of the major universities of the Russian Federation in order to provide accounting faculty, particularly those outside the ex-Soviet bloc, a broader international perspective of this important arena of accounting education: the introductory accounting course. In particular, this paper contributes to this arena by considering the nature of the matrix accounting theory approach adopted in the curriculum, and the reasons why, within the Russian context, this is

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an appropriate approach. The aim of this paper is not to suggest the widespread adoption of matrix theory within introductory accounting courses. However, the perspective provided could illuminate faculty and students' understanding of the role and purpose of accounting within the international context, and help faculty to recognize elements that could be included in accounting courses, or accounting programs more broadly.

The paper begins by describing the overall context of accounting education within the contemporary Russian system of higher education, before describing and evaluating the content and teaching of the introductory accounting course (called Accounting Theory¹) at the Southern Federal University of Russia (SFU), a course that extensively utilizes the matrix theory of accounting. Within this description and discussion, we address a range of issues of potential interest to U.S. and international accounting faculty.

The material on the place of accounting education within higher education in Russia contributes to an improved understanding of both accounting practice and the academy of accounting within the Russian Federation, which is one of the most important rising economies in international business and, therefore, the international accounting environment.

The content of the introductory accounting course at SFU is discussed in order to provide a range of potential insights by looking at this important part of the accounting curriculum from a very different perspective to that which dominates in the "West." From this alternative perspective, readers might be provoked to think anew about their experience of accounting education. Though a detailed comparison with "typical" introductory accounting courses in other international contexts is not provided, the rich description included allows readers to make their own comparisons,² and provides the basis to highlight specific issues of potential interest.

One of the striking features of the SFU introductory accounting course is the mathematical approach to accounting adopted: an approach that is predicated on the view that accounting is a mathematical science, and results, *inter alia*, in the inclusion of matrix accounting as a core theme of the course. The paper outlines the mathematical approach to accounting adopted and discusses some pedagogical insights of the effect of this on the teaching of accounting. In addition, the detail provided regarding the role, rationale, and integration of matrix accounting provides readers with an increased awareness of matrix accounting theory: a theory that is the basis of the accounting technology utilized in many modern ERP (Enterprise Resource Planning) type accounting systems. The discussion of the use of matrix accounting in this introductory accounting course will raise the awareness of readers of the possibility of incorporating matrix accounting ideas into the teaching of accounting, possibly at an introductory level, although more likely at more advanced levels in many accounting education environments.

The remainder of the paper is arranged in five sections. The first describes the context of accounting and accounting education in the Russian Federation. The second describes the introductory accounting course at SFU, including an introduction to the matrix accounting approach used, and the context of the course within the degree program. The third section discusses an evaluation of the course, and the final two sections discuss the issues arising, limitations, possible avenues for further research, and a range of conclusions.

¹ "Accounting Theory," the translation of the Russian course name, is used throughout this paper. This course is not an advanced accounting theory course of the type that may use this title in many U.S., U.K., and other English-language universities.

² A detailed comparison of the range of introductory accounting courses delivered internationally, or even across Russia more generally, is beyond the scope of this paper. However, the detailed data included in the text and appendices would allow others to do so, although as McGee and Preobragenskaya (2008) demonstrate in their comparison of accounting programs (primarily) between one U.S. and one Russian university, this is a problematic task.

THE CONTEXT

Within this section, we provide a brief description of the positioning of accounting education within the overall system of higher education (HE) within the Russian Federation. This is important as without an understanding of context, it would be difficult to relate the introductory course that is the subject of this paper in a meaningful way to other accounting courses; for example, those discussed in this journal and those with which readers have experience in practice.

There are over 1,000 universities and HE colleges within the Russian Federation, including state (approximately 60 percent) and non-state institutions. These institutions are categorized within a broadly hierarchical system as elite, federal, research, and classic universities, academies, and institutes. The total student population is in the order of 7.5 million,³ with approximately 800,000–850,000 graduates per year.

The system of university education has been under reform within the Russian Federation since the mid-1990s, triggered by the breakup of the Soviet Union and later motivated by the recent trend toward international standardization of education, both generally and in the field of accounting. One of the major changes has been and continues to be the move from five-year “specialist degrees” toward a structure of four-year “bachelor’s degrees,” with the option of extending study to six years with a “master’s degree.” Although this reform commenced over a decade ago, implementation has been delayed, with widespread changes in degree structures only being implemented recently. In many institutions, admittance to the new format degrees only commenced in 2009 or 2010, with some institutions delaying further. Many universities are currently delivering both traditional style (five-year) programs and new format (four or four-plus-two years) degrees. One reason for this being that some see the new structure as a threat to the education of the accounting profession (Pakhomova 2008).

Accounting in the Russian University System

Within the Russian Federation university system, and the Soviet system that preceded it, accounting education has typically been considered as a relatively minor specialism within the broad economics curriculum (in terms of numbers, popularity, and status). Historically, with a centrally planned economy, state ownership, and the absence of private property, accounting—and the forms of accountability that it facilitates—was not a high priority. The education of accountants was less important than the governmental administrative and control functions of bookkeeping, which did not demand a high status within the university system.

The Literature

There is a paucity of available literature on Russian accounting education from within the contemporary academy in Russia, possibly because of the past low priority given to accounting education. The majority of relatively recent literature relating to accounting education in Russia falls into two broad areas. First, there is the literature that prescribes the need for accounting in Russia to change in response to the increasing internationalization and marketization of its economy, and that discusses, in general terms, the resultant implications of this for accounting and finance education. The conclusion of this literature is, broadly, that there is a need to teach more international (rather than Soviet or Russian national) accounting and that there is a need for more faculty with adequate knowledge and teaching expertise in international accounting (see, for example, McGee [2008] and Labyntsev [2007]). Kovzik and Watts (2001) make similar observations about the economics curriculum within the Russian University system.

³ The total population of the Russian Federation is approximately 142 million.

Second, there is a very limited body of literature that looks at post-Soviet contemporary Russian accounting education by analyzing educational structures and curricular content. [Smirnova et al. \(1995\)](#) described the accounting education system as it existed soon after the break-up of the Soviet Union and discussed planned reforms, including the role of international participation in the future development of accounting education in Russia. Their analysis highlighted the high degree of central government control of the curriculum within universities, and observed that the system was based on an industrial or “assembly lines” ([Smirnova et al. 1995](#), 36) model of higher education.

[McGee and Preobragenskaya \(2008\)](#) compare the accounting degree curriculum in one of the St Petersburg universities with the curriculum in a U.S. university. While recognizing the limitations of their approach, they conclude that the students at the Russian university study marginally more accounting and finance in proportion to other subjects than those at the American university. They also observe that Russian students are generally considered to be well prepared by Big 4 accounting firms in Russia. However, they also note that coverage of international accounting methods (and standards) is problematic and is likely to remain highly variable among Russian universities, the main reasons for this being the continued importance of national Russian accounting and the lack of accounting academics with adequate knowledge and experience of Western (international) accounting.

In addition to [McGee and Preobragenskaya \(2008\)](#), [McGee \(2008\)](#) includes chapters (by a variety of authors) that cover, at least by association, other aspects of accounting education in Russia. [Djatej et al. \(2008\)](#) discuss how Hofstede’s cultural theory might provide insight into Russian culture and accounting, although their conclusions are relatively unspecific. Many of the other contributions reflect on the high degree of standardization within Russian (and prior Soviet) accounting practice, including the highly prescriptive chart of accounts and listings of allowable bookkeeping (journal) entries, which has had a significant effect on the content and structure of the accounting curriculum, a system discussed in some detail by [Bailey \(1990\)](#). [Urmenyhazi \(2008\)](#), in particular, details this by describing the *Korrespondenziya*, which is in a booklet issued by the Soviet Finance Ministry⁴ that sets out the standard chart of accounts with instructions on its use, including all the allowable combinations of debits and credits within journal entries ([Urmenyhazi 2008](#), 355, footnote 1).

Beyond the Literature

Given the lack of literature to provide the necessary context to appreciate the mathematical approaches adopted in the introductory accounting course at SFU, this section outlines important facets of the accounting education arena in Russia. In particular, we concentrate on those that relate to the nature of and attitudes to accounting as science⁵ and relate this to a commonly reported problem in the West: the need to ensure introductory accounting courses do not reinforce or engender negative perceptions of accounting and, therefore, discourage progress to advanced studies in accounting ([Albrecht and Sack 2000](#); [Mladenovic 2000](#); [Warren and Young 2012](#)).

The mathematical scientific approach to accounting as a discipline should not be confused with the highly rule-based methods of current accounting practice (as reflected in, for example, the *Korrespondenziya*). Clearly, the rules of the *Korrespondenziya* could be seen as a reflection of the

⁴ The *Korrespondenziya* is published in a booklet, along with the *Plan Schetov* (Chart of Accounts); many versions of this booklet have been published and officially adopted since the early U.S.S.R. versions of the 1940s to the current version, adopted in 2001 and approved by Order of the Ministry of Finance, 31.10.2000, No. 94n.

⁵ The observations in this section are made predominantly from personal experience within SFU and from contact with colleagues there and elsewhere with experience in other universities in Russia. Although these observations are made in good faith, they are not put forward as widely generalizable as they have not, to the authors’ knowledge, been formally researched or systematically investigated.

certainty of science (and mathematics in particular). However, the scientific approach of the academic accounting community is richer and more complex than this simplistic view and has to be considered within the context of the broad discipline of economics.

Economics and its constituent parts (including the separate disciplines of accounting and finance) are generally considered to be sciences within the Russian system and, as a consequence, these disciplines are largely approached from a logical positivist and, therefore, broadly mathematical or statistical perspective. Although the discipline of accounting has been heavily influenced by the practice of accounting and has, therefore, been shaped by social, political, and economic change, mathematical and scientific approaches to accounting are evident and significant. Recently, the mathematical scientific approach of economics has combined with the requirement for accounting education to reflect the dominance of information technology (IT) based approaches to accounting in practice to increase the demand for a mathematical approach to accounting, especially approaches that facilitate a logical (and sequential) solution to accounting issues. The use of the language of matrix algebra and situational-matrix modeling to describe and analyze the functioning of accounting has, therefore, become a popular (but not universal) approach to accounting.

In part, this move toward taking mathematical and IT-based scientific approaches to accounting is educational and functional, in that it is seen as a way of both improving accounting education and usefully developing accounting methods to be used in practice.⁶ In addition, the scientific approach of the academic accounting community includes perspectives that see accounting as a science to be researched in order to inform and develop the rules and the judgments that are, or should be, made in the application of the scientific method.

However, there are also political reasons for adopting this approach. Briefly (it is beyond the scope of this paper to analyze this issue in depth), the adoption and promotion of scientific approaches to accounting provides support in the promotion of the discipline within the university and social systems against the more dominant disciplines, particularly finance. Compared with the reported issues of student engagement in the West (Albrecht and Sack 2000; Mladenovic 2000; Warren and Young 2012, for example), the problem in Russian accounting education is more complex, as here the status of accounting within the university system appears to be under threat. It is not only, therefore, important to engender student interest, it is also important for accounting education to prove itself worthy of academic status.⁷

The increasing need for accounting and accountability with the rise in private ownership of businesses and the accepted increase in judgment required to report under (International Financial Reporting Standards) IFRS are beginning to improve the status of accounting and audit within the Russian Federation, both generally and within the nation's universities. However, accounting is still seen in many quarters as little more than bookkeeping, and accounting remains a subsidiary discipline within the economics degree programs of the major Russian universities. This is thought by some to be due, at least in part, to the perception of accounting in the academy as being insufficiently rigorous, difficult, or scientific. The adoption of mathematical approaches such as matrix accounting and situational modeling are, therefore, seen by some accounting faculty as ways to support and facilitate claims within the academy, and society more generally, that accounting should be considered as a science and, therefore, be treated with more respect.

This topic is considered further in the section on matrix accounting at SFU, including observations on the scientific claims of accounting.

⁶ See, for example, Kolvakh (2000) on the use of matrix algebra to formulate accounting models based on the principles of double-entry accounting.

⁷ There are parallels here with status problems that accounting as a discipline had in the past in some Western/Anglo-American university systems, although it appears that in these regions, accounting is now accepted as a valid part of most university systems, often within business school structures.

Accounting in the Southern Federal University

This section provides contextual information relating to the university and overall accounting program within which the introductory accounting course discussed in the remainder of this paper is situated.

The SFU Context

The Southern Federal University⁸ (SFU) is the principal university for the Southern Federal District of the Russian Federation. The SFU was created in 2006 in Rostov-on-Don as part of the program to create a cadre of “world class” universities within Russia, and was formed from the amalgamation of the Rostov State University and three associated institutions. The Rostov State University was established in 1915, which itself was created on the transfer of the academy from the Imperial University of Warsaw (Poland). The university is highly ranked within the Russian university system.⁹

The university has nearly 50,000 students distributed among 37 faculties studying over 200 fields of study. Within Economics and Management, students study 29 specialist fields and majors, including, *inter alia*, accounting and audit, finance, and taxation. The economics undergraduate program (Bachelor’s/Diploma) has an annual cohort of approximately 400 students, of whom approximately 10 percent study the accounting and audit specialism. The university has approximately 2,800 academic staff.¹⁰ The classification of faculty staff does not correspond well to U.S. (or U.K., Australian, or New Zealand) faculty ranks, although most academic staff are tenured or on tenure track. Within these faculty numbers, there are approximately 400 full doctors of science, most of whom are titled professor, a rank equivalent to full professors in the U.S. (professor in the U.K. and Australia). The next rank is candidates of science, which broadly covers both assistant and associate professor status in the U.S.,¹¹ of whom there are approximately 1,550 in SFU. In addition, doctoral students, approximately equivalent to graduate assistants but on the university payroll, are considered part-time members of academic staff (approximately 850 at SFU).

Program Structures: Accounting, Analysis, and Audit

At SFU, “accounting and audit” was offered both as a five-year “specialist degree” (the traditional structure) and as a specialist two-year “master’s degree,” following a general four-year economics “bachelor’s degree” (under the new Russian degree structure). There is no significant accounting content in the new bachelor’s degree. The content of the new format master’s “accounting and audit” degree will be based heavily on the relevant content in the old format “specialist degree” (with additional content) and, in consequence of this, many courses, including the Accounting Theory course that is the subject of this paper, have been designed with this shared structure in mind. The descriptions that follow are based on the specialist degree.¹²

The overall program structure for the undergraduate accounting and audit specialty degree, which is a stream within the undergraduate economics program, is provided in Appendix A. This

⁸ See: <http://dbs.sfedu.ru/www/site.english>

⁹ For example, ranked joint 9th (to 11th) in the Russian quality ratings (available at: http://www.finnode.fi/files/76/Russian_Universities_ranking.pdf), created by Finnode (available at: http://www.finnode.fi/en/russia/about_us).

¹⁰ There are an additional 3,600 research staff at SFU.

¹¹ Generally, Reader/Senior Lecturer or Lecturer in pre-1992 U.K. universities, and Reader/Principal Lecturer or Lecturer/Senior Lecturer in post-1992 U.K. universities, with similar role titles in Australia and New Zealand, although Associate Professor may be used as equivalent to Reader (partly similar to U.S. usage).

¹² As first entry to the bachelor’s degree commenced in 2011, entry to the master’s degree in accounting is not expected to commence until 2015.

shows the fairly broad range of subjects covered in the first year, including significant mathematics content, and the increasing specialization in later years. In addition to academic study, students complete periods of industrial and professional practice, roughly equivalent to internships within a U.S. context,¹³ as an integral part of the course program. The professional practice starts with two weeks toward the end of the second year and builds to six weeks at the end of the final year five.¹⁴ During these professional periods, students are expected to apply their theoretical learning in practice, learn about the overall cycle of accounting and financial work within the enterprise, and investigate questions of economic control and analyses.

As periods of professional practice are considered an important part of the program, they are formally structured, monitored, and certified by senior accounting personnel in the placement organizations. The certified reports, along with other documentation, including practice diaries, contribute toward summative student assessment. In addition, students collect material while on placement for summatively assessed work based on their work experience.

Accounting Faculty (Staff)

The accounting elements of the accounting program are delivered by staff in the Department of Accounting and Audit, consisting of one full professor, nine doctoral candidates, and three doctoral students, with faculty from other departments delivering other specialist courses, including those on finance and other general business subjects.

THE INTRODUCTORY ACCOUNTING COURSE

The introductory accounting course “Accounting Theory” was developed and introduced in 2000 by the department’s professor,¹⁵ and has recently been revised and developed with the participation of the other course staff. This course is a compulsory second-year (first semester) course for accounting and audit students. In 2009/2010, 32 students studied Accounting Theory, all of whom completed the course. The course is led by the professor; lectures are delivered by the professor and three doctoral candidates, and two doctoral students provide tutorial and other support.

Outline Structure

The course represents approximately 8 percent of a student’s annual study commitment, and in this context is roughly equivalent to a 2.5 hour course in the U.S.¹⁶ or a five-credit course in Europe.¹⁷ Over the 18 weeks of the semester, the course involves 72 class hours comprised of two

¹³ Various titles are used in (for example) the U.K., Australia, and New Zealand, including work placements, sandwich year/period, and Work-Integrated-Learning, as well as internships.

¹⁴ Periods of professional practice are a requirement of the Ministry of Education. All accounting programs were required to incorporate 16 weeks of professional practice; the program at SFU was not unique or unusual in this respect.

¹⁵ Professor and Doctor of Economics O. I. Kolvakh.

¹⁶ In the U.S., the norm is a total of “30 hours” per year, where hours refers (at least nominally) to the lecture hours per week within a semester, amounting to 120 hours for a first degree over four years. Although since 2001, a 150-hour requirement has been in place (normally over five years) for new members of the American Institute of Certified Public Accountants (AICPA), see, for example, [Allen and Woodland \(2006\)](#) for a discussion of the effect of the requirement.

¹⁷ Based on the credit values under the European Credit Transfer and Accumulation System (ECTS), within which students normally take a total of approximately 60 credits per year. In this system, one credit is intended to represent a total of approximately 25–30 hours of student study time—including class contact and self-study hours. *NB*, within university course descriptions, other credit value schemes may be used depending in part on the country; for example, the norm in the U.K. is 120 credits per annum (under which scheme this course would be ten credits).

lectures and two hours of tutorial time each week, in addition to which students are expected to devote around 74 hours to self-study. Formative assessment is provided throughout the course by way of grading and comments on prepared tutorial work, as well as lecturer and tutor feedback in classes. The course is summatively assessed by a two-hour end-of-year examination that consists of two sections. The first section covers theoretical issues (on matrix accounting) and the second is problem-based and predominantly mathematical and calculative in nature.

Content

The overall aim of the course is described in the introduction of the course document (see Exhibit 1). This introduction lays out the prime rationale and aims of the course, details the principle learning objectives of the course, and explains the role of matrix modeling with the course.

The content of Accounting Theory is split into the six broad sections:

1. Accounting and its place in the economic system;
2. The subject and aims of accounting;
3. Modeling as a means of theory development and improving methodology in accounting;
4. Concept of accounting information, equivalence, and transformation algorithms;
5. Accounting situational modeling; and
6. Methodology and methods of constructing system matrix and situation-matrix models in accounting.

The aims relating to each section are summarized in Appendix B, and a schedule of the topics and classes is set out in Appendix C. The detail shows that the initial topics of this outline, together with significant parts of the content that is imbedded in the sections on the matrix approach, are similar to the coverage in a traditional principles of accounting course in the U.S. (as, for example, outlined by [Warren and Young \[2012\]](#)). The matching of management accounting aspects is, however, less clear due to the lack explicit detail in the course specification. It is important to note that although the terminology used in the SFU outline might be read to indicate that the course is only concerned with external reporting, the course deals with reporting to both internal and external users.

The content and approach of the course are based on the Russian national accounting system, including learning the details of the standard chart of accounts that applies to all organizations,¹⁸ the nature of the allowable types of entries set out in the *Korrespondenziya*,¹⁹ and the standard report formats used within Russia for internal and external reporting. The course does not introduce the concepts or principles related to any forms of international accounting, although International Financial Reporting Standards (IFRS) and International Standards on Auditing (ISA) are taught in subsequent accounting and audit courses.

Modeling and Matrix Accounting

Principle, Approach, and Mathematical Rationale

This introductory accounting course, especially sections three through six, is highly shaped by concepts of modeling and matrix accounting theory that underpin the approach used within the accounting academy at SFU (and elsewhere) to support the cultural and social claims of accounting.

¹⁸ Actually, there are two standard charts of accounts: one that applies to commercial enterprises and the other to not-for-profit organizations.

¹⁹ Described in the introductory sections above.

EXHIBIT 1
**Introduction to the Course Accounting Theory
(Extracted from the course document [2010], translated by the authors from Russian.)**

Modern conditions of Russian economic development lead to the necessity to study accounting, as it is a major source of information for enterprise management and because the current state of development of the science of accounting highlights the importance of mathematical language in this area.

The aim of the course “Accounting Theory” at SFU is to provide a thorough comprehension of the ways of organizing accounting in the enterprises, and the study of the principles and methodology of matrix modeling in accounting. Knowledge of these principles will help graduates to form a full picture of the financial and credit functions, to appreciate accounting information on the status and movement of assets, and learn how to analyze large volumes of analytical information.

The objectives of the course also include studying the principles of the use of mathematical and modeling methods in accounting, the application of accounting information in different fields of economic activity and types of organizations, and providing a basis for future studies in the accounting and audit specialty.

On completion of the course, students should know and understand the following:

- The main principles of accounting theory;
 - The place of accounting in the management structure of the enterprise;
 - Be able to apply the appropriate accounting practices to different types of financial and economic activities;
 - Be able to calculate values of assets and liabilities and apply them correctly to improve operational efficiency, identify gaps and ways to overcome them;
 - Accounting organization in the enterprises and the content of the main accounting reports;
 - The principles of computerized accounting within enterprises; and
 - The principles of mathematical modeling and algorithmic accounting procedures.
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The rationale for the adoption of this approach has to be seen within the overall context of the position of accounting education in the Russian university system discussed in the earlier section, both with respect to student engagement and claims for academic status. The professor of accounting in the department has clearly been a strong influence in this respect. His research and teaching interest is strongly informed by the potential of these mathematics-based approaches to develop new scientific methods of accounting,²⁰ to aid the analysis of different forms of accounting and the effects of accounting judgments, and, therefore, to inform the debate on the development of appropriate rules and judgments in the theory and practice of accounting. The rest of this section sets out the development and rationale of the approach adopted.

Elements of a modeling approach are common (even if not explicitly recognized as such) in the teaching of accounting. At the simplest level, modeling is evident in the use of the balance sheet equation ($\text{Assets} - \text{Liabilities} = \text{Capital}$) and the modeling of profit as increases in capital adjusted for consumption or distribution ($\text{Profit} + \text{Consumption} = \text{End of Period Capital} - \text{Beginning of Period Capital}$). These models are commonly used in accounting textbooks²¹ and are embedded in the concept of double-entry bookkeeping that is the foundation of modern accounting.

²⁰ See, for example, [Kolvakh \(2000\)](#) on the use of matrix algebra to formulate accounting models based on the principles of double-entry accounting.

²¹ See, for example, [Wood and Sangster \(2008\)](#), one of the most widely distributed English-language texts on bookkeeping and accounting, and from the U.S., [Wild \(2011\)](#).

The use of modeling concepts highlights the logical nature of accounting as a form of representation of financial reality. This, combined with the use of the mathematical approach and adoption of matrix accounting, is a major element of the “accounting as science” approach that is prominent at SFU. Within matrix accounting, the explicit modeling goes further than that of the accounting equation and the duality of accounts. This is achieved by mathematically modeling economic events, such as transactions, and their effect on accounts and account balances using matrix algebra, via the use of “situational modeling.” The use of matrix models in this way extends the mathematical analysis of accounting and facilitates the building of both operational accounting systems using mathematics²² and mathematical extrapolative models of accounting results.

The idea of matrix accounting is not new. It is, however, unusual for introductory accounting to be taught via such a modeling approach (in Russia, as well as in the West). Mephram (1988) and Mattessich (2008) trace the origins of matrix accounting to Augustus De Morgan (1846), and Mattessich (2008) credits Rossi (1889) with the earliest extensive expositions on the subject. The matrix modeling approach used at SFU has lineage to the macro accounting concepts Leontief advanced in the 1930s and 1940s,²³ which was developed by Mattessich, among others, in the 1950s (see Mattessich 2005; Mattessich and Galassi 2000) and further developed in the 1980s by, for example, Leech (1986), Mephram (1988), and Babad and Balachandran (1989).

The use of the mathematical matrix modeling approach is significantly different (in both theoretic and practical senses) to the procedural nature of the traditional way of learning how to produce financial statements that is used in many conventional introductory accounting courses. In many such courses, even if the full nature of double-entry bookkeeping is not covered, the production of accounts is often learned alongside the procedures of creating accounts from, for example, a trial balance. In contrast, by using mathematical methods, matrix accounting can provide a verifiable process that leads to balanced accounts that reflect duality.²⁴ Further, the matrix method provides a very compact procedure that can simultaneously reproduce the data balances and various reports by transforming the results, thereby supplying a “device” of modeling that delivers:

1. Compactness of representation of accounting data, as well as the required transformation of these data as appropriately formatted reports.
2. A way of eliminating the complex procedural steps of traditional bookkeeping.
3. Compactness and transparency of the logical reasoning and results.

By doing so, it is argued (see, for example, Kolvakh 2011) that the matrix and situational modeling approach could be a significant aid to communications, both within the disciplinary practice of accounting and between practitioners of accounting and other professional spheres. In the former case, Kolvakh (2011) argues that, for example, in relation to the global harmonization of accounting, the use of the universal language of mathematics²⁵ could, in addition to alleviating translation difficulties, aid the analysis of the effect of policy changes and different accounting practices.²⁶ In the latter case, it is arguable that the language of mathematics might facilitate communications between accounting and software and information technology developers,

²² The exposition of these models is beyond the scope of this paper; however, the theories, along with examples, are set out in Kolvakh (2011).

²³ Wassily Leontief was awarded the Nobel Prize for Economics in 1973 for his matrix-based macro accounting inter-industry balance/input-output model.

²⁴ Verifiable in the sense that they can be mathematically proven; for example, see Kolvakh (2011) for details of the proof of first two “postulates of Pacioli.”

²⁵ Mathematics being a (near) universal language in the sense that its representation is the same in almost all language areas.

²⁶ By providing prototype mathematical models of (global) accounting that can be manipulated to reflect different choices.

particularly in relation to the development and implementation of efficient accounting information systems, particularly as matrix algebra is utilized in many modern information systems, including many ERP (Enterprise Resource Planning) systems.

In addition, the matrix approach, as reflected in the structure of this Accounting Theory course, facilitates the integration of management and financial accounting (financial reporting), as the same basic model is used both to record transactions and to model forecasts of the financial effects of decision options. Further, it does this in a compact and efficient way that, at least for demonstration purposes, is relatively easily implementable within spreadsheet environments;²⁷ an approach that has significant learning potential and is used extensively at SFU, and is discussed in the next section.

Beyond pure accounting, the matrix model can also be seen as a more universal method of modeling economic relations with any primary data (including nonfinancial data) in a manner that preserves the duality of double-entry bookkeeping. In principle, the matrix model means that all such data manipulations can be reduced to known mathematical transformations, via formulas that can be visible and logically reproducible (due to the uniformity and efficiency of matrix algebra). Thereby, double entry can be regarded as a universal method of modeling, not only in accounting but also in other fields of economics, including economic theory.

Teaching of Matrix Accounting: The Approach Taken

Students, who are expected to be strong in mathematics for entry to the degree and who study mathematics within other compulsory courses of the curriculum,²⁸ are taught the matrix modeling approach (as described by Kolvakh [2011]) in order to strengthen their logical understanding of the processes and results of accounting. In part, this is achieved by reducing the diversity of accounting procedures required to convert primary transaction data to balance sheets and accounts to mathematical transformation formula. An introduction to this section of the course is provided to students via a website²⁹ that sets out the basic form of the mathematics and provides a simple self-test.

Further development of the principles contained in this approach is taught to allow the modeling of various accounting situations, enabling different forms of analysis, including methods of forecasting the impact of transactions on the financial position and results of an organization; useful for business planning. In part, this is achieved by using and developing the situational modeling approach, which uses the linear dependencies between groups of transactions that are involved in common business processes to allow simplified (compact) matrix manipulation to be used. This process creates the possibility of constructing analytical models to help predict the dynamics of business processes, including the effects of exogenous variables on future accounting reports.

One of the specialist aspects that is taught and is well suited to the use of matrix form accounting is the topic of “Chess balances,”³⁰ which are used to organize and present summary information on accounting entries for a period in tabular form, a form that is considered very

²⁷ Although used in a different context, Franz (2004) illustrates the use of spreadsheets to perform matrix algebra in a management accounting teaching case.

²⁸ These include, *inter alia*, linear algebra, calculus, and probability theory, as well as econometrics.

²⁹ The site is available (in Russian) at: <http://www.smm.rsu.ru/smm/>; the course topics are in the panel on the right. Although in Russian, viewing these pages via an online translation service (such as Google Translate, available at: <http://translate.google.com/>) provides a reasonable representation of the nature of the material.

³⁰ A method noted in the detailed curriculum (see Appendix B and footnote 36) that is based on Leontief’s input-output model that is also the basis of the matrix accounting model, and is facilitated by the use of matrix methods within computerized systems.

informative, particularly for non-profit enterprises. The calculation of these balances is cumbersome using traditional bookkeeping methods; however, it is a natural outcome of matrix accounting, as it is the sum of the transaction matrices for the period.

At a practical level, lectures are used to impart information and, in particular, to present the theoretical basis of matrix accounting and to discuss its use and implications. Tutorials and workshops are used to reinforce students' learning and to ensure they understand the transformations and can apply the theory of situational modeling to practical example problems. Students are expected to use mathematical methods to achieve solutions in class, many of which involve students building Excel (spreadsheet) models³¹ to structure the matrix algebra by implementing the theory introduced in lectures, and to enter transaction data to solve specific transformation operations.

Pedagogical Approach

The pedagogical approach taken in the Accounting Theory course is generally a strongly didactic, teacher-directed approach to education. In addition, the subject content is largely taught in a dualistic³² way, predominantly presenting issues of accounting practice as having single correct answers and encouraging students to think of the practice of the subject as one in which it is important to follow the rules. In many ways, this is reflective of the highly regulated and rule-based process of accounting (and, indeed, other aspects of society) that predominate in Russia, and were at least as prevalent in the previous Soviet systems.

In general, this approach to teaching and the nature of accounting (and other subjects within the broad economics discipline) is continued throughout the undergraduate degree program. To some extent, this approach can also be seen to be shaped by (or shaping of) the view of accounting and economics as a science, which is reflected in the statement of aims of the course, as outlined above. However, students are encouraged to discuss and challenge practice from a theoretical perspective, and to develop a deeper understanding of accounting theory and how the science of the mathematics that underlies accounting can be used to facilitate the analysis of accounting choices. Although, to some extent, the current cultural context of the discipline and institution militate against the development of this questioning approach to learning, there is a desire among faculty involved in the course to change this perspective further. A consequence of the cultural context is that the course, and the degree program in general, is not highly abstract and theoretical. This is, to some extent, reinforced by the periods of practical experience and by the use of many practical examples within the Accounting Theory course, including computer-based workshops, practical tutorial examples, and case study assignments.

EVALUATION AND STUDENT VIEWS

At a general level, Accounting Theory is seen as a successful course within the discipline and the university, both in terms of the pass rate achieved (100 percent in the current year)³³ and in terms of the perception of faculty. Accounting faculties see the course as providing a sound foundation for higher-level study in the discipline and as being popular with students.

³¹ Though students are often given spreadsheet files to work from, these typically contain only the basic data; for example, opening balances, and are not detailed solution templates.

³² Using the terminology of Perry (1970) and the research tradition of intellectual and ethical development based on his early research in this area.

³³ Although this is not exceptional in the faculty (most students pass most courses, due to their high extrinsic and cultural motivation to do well and complete their studies), it is better than the norm, which is approximately 5 percent failures on individual courses.

Formal systematic course evaluation procedures involving student feedback are not the norm within the SFU. Given the culture of deferential hierarchy in the university, this is perhaps unsurprising, as students are not encouraged to question or criticize the professoriate.³⁴ Despite this, a questionnaire was used to elicit student opinions and judgments on the course. While it is recognized that student evaluations of teaching are problematic, it is believed that the surveys here provide data that are useful to make at least provisional judgments on students' views of the course, methods adopted, and topics covered. One reason for this opinion is that the students showed a positive attitude to being asked for their views. Given the nature and extent of the data and the exploratory nature of the evaluation, the data obtained are not subjected to statistical testing and are not presented here in detail.³⁵ For these reasons, these data are only used to make a tentative summary evaluation, and there is no suggestion that the evaluation has general applicability.

The detailed questionnaire was administered in class in the second quarter of 2010, surveying the views of accounting and audit specialty students who had recently completed the course and (separately) students who had completed the course in 2008/2009,³⁶ by one of the course teachers. The survey instruments asked students to provide views on 37 items on a five-point scale (strongly agree to strongly disagree, plus not applicable) and to provide text answers to nearly 20 other questions. The survey was divided into three principal sections: views on the Accounting Theory course, views on the matrix accounting section of the course, and general questions about themselves and their views on accounting.³⁷

Of the 32 students currently in the course, 31 (97 percent) completed the survey, and of the 32 students of the prior cohort, 25 (78 percent) students completed the survey. Of the current students, 26 (84 percent) were female and all were aged 18 or 19; all of the prior-year students who responded were female with ages of 19 or 20.³⁸ In summary, the course was generally rated positively,³⁹ although the prior cohort seemed, on balance, to be marginally less positive than the current cohort. Students agreed, as would be expected, that the course added to their understanding of accounting and that they found it interesting. However, neither cohort indicated a large increase in motivation to study or to pursue a career in accounting. It is, however, entirely plausible that by choosing this specialist degree, they had already shown a high motivation to do so. In line with this, both cohorts displayed similar generally positive attitudes to accounting, and the vast majority of students intended to pursue accounting careers (83 percent of current cohort; 90 percent of prior cohort). Related to this, it is clear that both cohorts have positive views of the importance of accounting to management, business, and government. These views are encouraging in that they indicate that this course does not seem to reinforce the negative stereotypes that for many years have been a cause for concern for introductory accounting courses, albeit in other cultures (Albrecht and Sack 2000; Mladenovic 2000; Warren and Young 2012).

The questions relating to the matrix accounting section of the course generally show a moderately⁴⁰ positive view of its contribution, and students seemed to view the matrix section as

³⁴ In addition, students are known to be aware that they rely on the goodwill of teaching staff, who could earn much more outside the university sector, which, combined with high faculty turnover rates, increases students' deferential attitude to faculty.

³⁵ A more detailed analysis is available from the first author.

³⁶ All relevant ethical and administrative approvals were granted by the university.

³⁷ The survey instruments (in Russian and English) are available from the first author.

³⁸ The gender composition of the class reflected in these proportions is clearly significant, but consideration of the gender profile of the discipline is beyond the scope of this paper.

³⁹ Mean scores the positive side of the neutral score, 3, with more positive than negative ratings.

⁴⁰ Given that matrix methods constitute a large proportion of the accounting theory, it is understandable that scores in this section are moderate, as their views on the subject as a whole will have been heavily influenced by their exposure to matrix methods.

fitting well within the course, one of the most useful aspects of the course, supportive of their understanding, interesting and enjoyable. In this respect, it seems that the matrix accounting has a potential in this environment to help engender student engagement with accounting. It is interesting that in this context, the fear of Albrecht and Sack (2000) that concentration on the mechanics of bookkeeping is an important cause of student disengagement is not represented. The opposite appears to be the case. Whether this is due to the nature of attitudes to science and to accounting in Russia, or whether it is because of the inherent advantages of this integrated modeling approach is, however, an open question.

From both a student and an institutional perspective, and in terms of results and student engagement, the Accounting Theory course can, therefore, be seen to be broadly successful.

DISCUSSION, LIMITATIONS, AND FURTHER RESEARCH

The introductory accounting course described, contextualized, and evaluated above is clearly a single example of the way this important course is delivered in one of the many Russian Federation universities. Therefore, despite the positive course evaluation, this case is not presented as either a typical or an outstanding introductory accounting course in any sense. Nor, by introducing the reader to this course and a range of issues arising, is it suggested that it provides a model or ideal syllabus that could be lifted from its Russian context and used elsewhere. By providing information and analysis of this course, it is hoped that readers may gain useful insights into how the courses with which they are involved fit within accounting education in a broader international context, and also gain insights from the content and approach taken. The specific use of matrix accounting and the general mathematical scientific approach introduced is particularly novel from a Western perspective.

Also, no claim is made that the way this course is presented is typical of introductory accounting courses in Russia. However, while (to our knowledge) no systematic study has been published or carried out on the teaching of matrix accounting in other Russian universities, we are aware that matrix accounting theory is introduced elsewhere in Russian university courses,⁴¹ at introductory and higher levels.

Clearly, there is scope for further research into the content of introductory accounting courses and the theoretical and learning approaches taken within these courses across the universities of the Russian Federation, as there is for accounting education elsewhere in the world. Although this paper adds to our understanding, it is important to recognize its limitations. Not only is this a single case, it also has to be recognized that the higher education situation in Russia is not stable, and there is research that suggests there is need for change in the content and approach taken within accounting education. In this context, Lapshina (2009) calls for the adoption of approaches similar to the innovations that have been introduced at SFU, including the use of situational modeling (situational simulation), “learning by doing,” and the increased use of information technology.

However, in light of the culture and status of accounting issues discussed, it is clear that the issue of the attitude of other disciplines within the academy provide a far more serious and overarching concern, and that this is an issue that deserves further research and analysis. Although there are many interesting avenues for further research in this area, it is possible that a fuller cultural analysis, possibly utilizing the Hofstede methodology, would be fruitful, not least as the national cultural profiles are so different.⁴²

⁴¹ For example, at the Stavropol State University (available at: <http://www.stavsu.ru/>).

⁴² See, for example, the clear differences between <http://geert-hofstede.com/russia.html> and <http://geert-hofstede.com/united-states.html> (Russia has much higher power distance and uncertainty avoidance indicators than the U.S., the U.K., or Australia and New Zealand, and much lower Individualism and Masculinity/Femininity indicators).

In terms of content and approach employed, the case has potential value in areas other than the prime issues that are addressed in the concluding section. These arise from consideration of the overall degree program and the place of the introductory accounting course within it. First, the basic content and aims of the introductory accounting course at SFU, apart from the inclusion of matrix accounting, are broadly similar to the content that will be found within early courses in accounting degrees in other parts of the world. Therefore, to some extent, comparisons could be made with Western courses that readers are more likely to be familiar with.

However, one of the most interesting issues here is the open question regarding reasons for the results found relating to student engagement, with which we closed the evaluation section. It appears that student perceptions at SFU of the matrix modeling aspects of this course seem to be contrary to the expectations expressed in [Albrecht and Sack \(2000\)](#) and reflected in subsequent research and commentaries (up to and including [Warren and Young \[2012\]](#)), that the mechanics of transaction recording discourage students from pursuing accounting studies. This indicates a potentially significant avenue for research, particularly within the Russian context, but also potentially in other environments. It is also possible that the mandated periods of professional practice (internships) spread throughout the degree provide an interesting opportunity for further research from a barriers-to-learning perspective. This practical experience is likely to go some way to help the contextualization of accounting and the learning of skills, the lack of which is sometimes a barrier to accounting students' learning ([Stoner and Milner 2010](#); [Milne and McConnell 2001](#)).

CONCLUSIONS

The internationalization of accounting is clearly increasingly important as the process of economic globalization proceeds and accelerates. In accounting terms, this is often seen as the need to recognize and learn about the international harmonization of financial reporting (involving the teaching of IFRS GAAP). However, it is also important to recognize national differences that affect the training and cultural approaches of accountants from different parts of the world (particularly within the major economies, such as the Russian Federation), not least as the large accounting firms operate in those countries, see them as areas of opportunity, and employ locally trained staff. In addition, the globalization of accounting education increasingly means that faculty are exposed to students who have studied their accounting elsewhere in the world. This is one of the contexts in which this paper provides a contribution in internationalization terms, as it provides information on accounting practice and accounting education in the Russian Federation.

In terms of content and approach, the most striking aspect of this course is the overall mathematical and modeling approach adopted at the core of the course. In line with most introductory accounting courses, the Accounting Theory course at SFU is based on the underlying concepts of the information content and economic meaning of the prime financial statements. As is common elsewhere, the development of students' comprehension and learning is based on the prime model of accounting: the accounting equation. However, instead of including double-entry bookkeeping (including the processes of recording transactions through the ledgers and the production of accounts) merely as a process of practice, the Accounting Theory course proceeds to model transactions as mathematical transformations. Further, the course concludes by providing mathematical proofs that the processing, via matrix algebra, ensures the duality of double-entry bookkeeping and accounting.⁴³ This is an interesting approach, and one that reinforces the mathematical scientific nature of accounting, as well as the links between financial reporting and management accounting, which it does by providing a recording and transformation process that links the recording of the past with methods of modeling forecasts of the future.

⁴³ Represented within the course as the proof of "Pacioli's and Pizani's postulates."

The use and extent of integration of matrix accounting theory in this introductory course is clearly notable from the detailed course aims (Appendix B) and topic outline (Appendix C) as, from the third section of the course, this modeling approach dominates the delivery and is integrated into both the processing and conceptual aspects of the course. As observed in the evaluation section, students' views of this aspect of the course were generally positive, which provides *prima facie* evidence that this approach contributes positively to students' understanding of accounting and the processes of manipulating accounting data. Within the Russian context, Lapshina (2009) supports the more widespread adoption of this type of modeling. Looking from a different (Western) perspective, it is interesting how this emphasis on the apparently mechanical process seems to increase student engagement rather than alienate students, which appears to be one of the main concerns of the work on perceptions following Albrecht and Sack's (2000) predictions in relation to double-entry bookkeeping. Although clearly, in the absence of further research, it would be premature to suggest this is primarily due to the use of matrix accounting, rather than national or institutional effects. It is, however, plausible that this is because of the greater perceived usefulness of the matrix approach, as it integrates with decisions rather than represents mere recording.

For many reasons, the success or otherwise of a modeling and mathematical approach to the teaching of accounting will be influenced by the context in which it is implemented. In Russia, there is a culture that has traditionally been heavily influenced by a rules-based approach to both academic study and accounting, as well as in society generally. Whereas in much of the West, accounting (particularly at introductory levels) is seen as a discipline of professional practice,⁴⁴ within Russia, it is evident that accounting is seen and promoted by many academics as a science. In this environment, it is plausible to believe that the mathematics-based matrix accounting theory approach to accounting is more likely to be successful than elsewhere.

For this reason alone, from a non-Russian perspective, the wholesale adoption of a matrix approach (particularly in the short term) is probably impractical for many reasons. These reasons include the lack of appropriate resources, insufficient faculty expertise, and, possibly most critically, the local history and culture of the discipline of accounting that has not seen the value of this theoretical approach. The latter is evidenced by the low level of response to the publications of, *inter alia*, Mattessich from the 1950s (Mattessich 2005; Mattessich and Galassi 2000), Leech (1986), and Mephram (1988). However, especially when considered alongside other issues raised in this paper regarding the mathematical approach, it is possible that in some circumstances (for example, where accounting is taught in joint programs with mathematics and computing science), such an approach could be beneficial, and in others, the inclusion of aspects of the matrix approach could broaden and enlighten the curriculum.

Looking at the teaching of introductory accounting courses in other societies with different cultures and different economic traditions will not provide easy solutions or readymade approaches to our teaching. However, looking at the context and detail of such courses provides alternative perspectives of our discipline and the ways in which it might be taught and learned. To quote one of the anonymous reviews of this paper:

[A]ccounting is not as universal as some commentators like . . . to believe.

These different perspectives encourage us to think about new approaches to our discipline, different topics and new ways of presenting them that may help us to enliven our teaching of accounting. This is a particularly important issue in relation to introductory courses, not least because of the potential of these courses (being each student's first exposure to accounting at

⁴⁴ Further, in some areas, particularly among European accounting faculty, accounting is seen as an inherently political and social process.

university) to have a long-lasting effect on every student's approach and attitude to the discipline. It is, therefore, hoped that the main contribution of this paper, and others like it, will be to help us think afresh about our discipline and how we present it to our students.

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APPENDIX A

Overall Program Structure: Specialist Degree in Accounting and Audit (Five-Year)

Year 1

Course/Semester	Class Hours				Acc and Audit**
	Total	Weekly		Total	
		Lectures	Tutor		
Year 1/Semester 1 (18 Weeks)					
Foreign language (English)	68	—	4	4	
National history	36	2	—	2	
Russian language and oral culture	18	—	1	1	
Economics (micro)	54	2	1	3	
Linear algebra	72	2	2	4	
Computers	54	1	2	3	
Cultural Studies	18	1	—	1	
Safety course	36	—	2	2	
Introduction to the specialty	18	1	—	1	**
Optional courses (1 of)					
Political economy	36	2	—	2	
Economic history	36	2	—	2	
Total Hours (without physical trainings)	<u>410</u>			<u>23</u>	
Physical trainings	94	—	5	5	
Year 1/Semester 2 (17 Weeks)					
Foreign language (English)	102	—	6	6	
Economics (macro)	51	2	1	3	
Calculus (Mathematical analysis)	68	2	2	4	
Computers	51	1	2	3	
Concepts of modern science	34	2	—	2	
Economic geography and regionalism	34	2	—	2	
Optional courses (1 of)					
Environmental economics	36	1	1	2	
History of political parties	36	1	1	2	
Total hours (without physical trainings)	<u>376</u>			<u>22</u>	
Physical trainings	102	—	6	6	

** Classes marked with asterisks are taught by the accounting and audit department.

Year 2

Course/Semester	Class Hours				Acc and Audit**
	Total	Weekly		Total	
		Lectures	Tutor		
Year 2/Semester 3 (18 Weeks)					
Philosophy	36	2	—	2	
Theory of probabilities and mathematical statistics	54	1	2	3	
Economic-mathematical methods	36	1	1	2	
Business organizations (enterprises)	36	1	1	2	
General theory of statistics	36	1	1	2	

(continued on next page)

APPENDIX A (continued)

Course/Semester	Class Hours				Acc and Audit**
	Total	Weekly		Total	
		Lectures	Tutor		
World economy	36	1	1	2	
Money, credit, banks	72	2	2	4	
Theory of accounting	72	2	2	4	**
The theory of economic transition	54	2	1	3	
Total hours (without physical trainings)	<u>432</u>			<u>24</u>	
Physical trainings	54	—	3	3	
Year 2/Semester 4 (17 Weeks)					
Jurisprudence (law)	34	1	1	2	
Economic and mathematical models	68	2	2	4	
Socio-economic statistics	34	1	1	2	
Finance	68	2	2	4	
History of economic thought	34	1	1	2	
Sociology	17	1	—	1	
Politics	17	1	—	1	
Financial accounting	68	2	2	4	**
Specialist "Accounting and Audit" ^a					
Financial and commercial environment in the Internet	34	—	2	2	
History of accounting	51	2	1	3	**
Total hours (without physical trainings)	<u>425</u>			<u>25</u>	
Physical trainings	51	—	3	3	
Coursework—Financial accounting					
Educational and industrial practice (two weeks)					

** Classes marked with asterisks are taught by the accounting and audit department.

^a Courses below the specialist degree heading (each semester) are open only to accounting and audit specialist students; other courses taught by the department are available to students on other specialist programs (in most cases, the finance and credit specialty).

Year 3

Course/Semester	Class Hours				Acc and Audit**
	Total	Weekly		Total	
		Lectures	Tutor		
Year 3/Semester 5 (18 Weeks)					
Psychology	18	1	—	1	
Econometrics	54	2	1	4	
Management	36	1	1	2	
System of national accounts	36	1	1	2	
Taxes and taxation	72	2	2	4	
Theory of economic analysis	36	1	1	2	
Business communication	36	1	1	2	
Management accounting	72	2	2	4	**
Specialist "Accounting and Audit" ^a					
Trade accounting	36	1	1	2	**
Optional courses (0 or 1 of)					
Civil law	<u>36</u>	2	—	<u>2</u>	

(continued on next page)

APPENDIX A (continued)

Course/Semester	Class Hours				Acc and Audit**
	Total	Weekly		Total	
		Lectures	Tutor		
Total hours (without physical trainings)	<u>396 or 432</u>			<u>23 or 25</u>	
Physical trainings	36	4	—	4	
Coursework—Managerial accounting					
Year 3/Semester 6 (17 Weeks)					
Pedagogy	17	1	—	1	
Marketing	34	1	1	2	
Statistics in finance	34	1	1	2	
Control and revision	34	1	1	2	**
A comprehensive analysis of economic activity	68	2	2	4	
Audit	72	2	2	4	**
Laboratory workshop on accounting	68	—	4	4	**
Specialist “Accounting and Audit” ^a					
Accounting for Foreign Economic Affairs	51	2	1	3	**
Interbank payments and international payment systems	51	2	1	3	**
Accounting on PC (1-C)	68	—	4	4	**
Total hours (without physical trainings)	<u>497</u>			<u>29</u>	
Physical trainings	34	2	—	2	
Coursework—Comprehensive economic analysis					
Industrial practice (four weeks)					

** Classes marked with asterisks are taught by the accounting and audit department.

^a Courses below the specialist degree heading (each semester) are open only to accounting and audit specialist students; other courses taught by the department are available to students on other specialist programs (in most cases, the finance and credit specialty).

Year 4

Course/Semester	Class Hours				Acc and Audit**
	Total	Weekly		Total	
		Lectures	Tutor		
Year 4/Semester 7 (18 Weeks)					
Securities market	54	2	1	3	
Tax law	54	2	1	3	
Accounting financial statements	54	2	1	4	**
Laboratory workshop on accounting	72	—	4	4	**
Audit-2	34	1	1	2	**
Specialist “Accounting and Audit” ^a					
Tax payments in financial accounting	36	1	1	2	**
Optional courses (1 of)					
Methods of analysis and data processing	36	1	1	2	
Accounting for commercial banks	54	2	1	3	**
Accounting for small enterprises	54	2	1	3	**
Total hours (without physical trainings)	<u>340 or 358</u>			<u>20 or 21</u>	
Physical trainings	18	—	1	1	
Coursework—Accounting financial statements					

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APPENDIX A (continued)

Course/Semester	Class Hours				Acc and Audit**
	Total	Weekly		Total	
		Lectures	Tutor		
Year 4/Semester 8 (17 Weeks)					
Information systems in economics	68	2	2	4	
Financial management	68	2	2	4	
Insurance	34	1	1	2	
Financial statements analysis	68	2	2	4	
Laboratory workshop on accounting	68	—	4	4	**
Optional courses (1 of)					
Crisis management company	51	2	1	3	
Accounting for non-profit organizations	34	1	1	2	**
Salary and personnel management	34	1	1	2	**
Total hours (no physical trainings)	<u>357 or 340</u>			<u>20 or 21</u>	
Coursework—Audit					
Industrial practice (four weeks)					

** Classes marked with asterisks are taught by the accounting and audit department.

^a Courses below the specialist degree heading (each semester) are open only to accounting and audit specialist students; other courses taught by the department are available to students on other specialist programs (in most cases, the finance and credit specialty).

Year 5

Course/Semester	Class Hours				Acc and Audit**
	Total	Weekly		Total	
		Lectures	Tutor		
Year 5/Semester 9 (18 Weeks)					
IFRS (International Financial Reporting standards)	54	2	1	3	**
ISA (International Standards of Auditing)	36	1	1	2	**
International business	36	2	—	2	
State regulation of economy	54	2	1	3	
Restructuring ownership	54	2	1	3	
Audit	34	1	1	2	**
Accounting	36	1	1	2	**
Investment analysis	54	2	1	3	
Optional courses (1 of)					
Economic mentality and the political elite in Russia	36	2	—	2	
Modern strategies for environmental	36	2	—	2	
Accounting and analysis of bankruptcy	72	2	2	4	
Total hours (without physical trainings)	<u>394 or 430</u>			<u>22 or 24</u>	
Physical trainings	19	—	1	1	
Year 5/Semester 10 (18 Weeks)					
Pre-diploma practice (six weeks)					
Preparation of final assessed (degree/diploma) papers					

** Classes marked with asterisks are taught by the accounting and audit department.

^a Courses below the specialist degree heading (each semester) are open only to accounting and audit specialist students; other courses taught by the department are available to students on other specialist programs (in most cases, the finance and credit specialty).

APPENDIX B

DETAILED AIMS OF THE COURSE ACCOUNTING THEORY

(Translated and adapted from the main course document: by the authors.)

1. Accounting and Its Place in the Economic System

Types of accounting and the concept and features of accounting.

Classification of assets by their types and purpose and economic grouping of enterprise assets.

Classification of liabilities, capital, and borrowings.

The structure of business processes and the representation of these in financial reports.

2. The Subject and Aims of Accounting

The accounting discipline: objects and purposes of accounting, basic accounting principles, the organization of accounting in the enterprises, accounting and transaction documentation and classification [*types of primary documents and reports*].

The form and structure of the balance sheet, its construction, and its economic meaning. Types and formats of balance sheets.

The influence of economic processes within the enterprise on balance sheet account balances: four types of balance changes caused by transactions.⁴⁵

System of accounts and double entry. The concept of accounts, their types, structure, and purposes in accounting system, and how they relate to the balance sheet.

Classification of accounts according to their purposes and the [official standard] chart of accounts.

The principle processes of double-entry accounting: Systematic and chronological records and the notion of account correspondence and types of entries, including current standard forms (*Korrespondenziya*).⁴⁶

Chess balances.⁴⁷

3. Modeling as a Means of Theory Development and Improving Methodology in Accounting

The concept of matrix and situational modeling⁴⁸ as accounting language.

The balance [accounting] equation in matrix modeling.

Methodological problems of matrix modeling algorithmization.

Examples of matrix modeling algorithmization of financial activities.

⁴⁵ All transactions affecting the balance sheet can do so in one of four ways, depending on their content: 1. increase one asset and decrease one asset (Dr.A, Cr.A); 2. increase one asset, increase one liability (Dr.A, Cr.L); 3. decrease one liability, decrease one asset (Dr.L, Cr.A); and 4. decrease one liability and decrease one liability (Dr.L, Cr.L)

⁴⁶ The standardized “book” of journal types, described in the main text.

⁴⁷ “Chess balances” is a method of recording counterparty transactions (within both traditional double-entry and matrix accounting) in balanced matrix-like format, where transactions are, in effect, added to cell balances at the intersection of the row that represents one account and column that represents another. Row totals represent the total debits on accounts and column totals the credits. As row totals should equal column totals, the chess balance is achieved when row totals sum (cross-cast) to column totals (down-cast) and, therefore, balance. This method derives from use within Soviet macro-level accounting for inter-industry transfers, and is used within accounting entities where turnover is not accounted for in traditional trading account format.

⁴⁸ Situational modeling is also referred to as situational simulation.

4. Concept of Accounting Information, Equivalence, and Transformation Algorithms

Different uses of accounts (internal and external) and their information requirements, and how these can be theoretically shown to be based on shared data (equivalence concept). The use of transformation algorithms and matrix mathematics to provide information for different user requirements, including formats and presentation.

The logical-mathematical and syntactic forms of equivalence of accounting transformations/algorithms. Classification and equivalence of accounting methods.

5. Accounting Situational Modeling

Situational modeling as the modeling of groups of accounting entries that arise from linked transactions (situations), their formulation into algorithms and mathematical form: formulation problems and issues.

Conceptual foundations of the creation and interpretation of charts of accounts.

Example situations, models, and applications.

6. Methodology and Methods of Constructing System Matrix and Situation-Matrix Models in Accounting

Matrix models of chess balances and the accounting model (transactions to balance sheet).

The mathematical proof, within situation-matrix modeling, of Pacioli's and Pizani's postulates of duality in double-entry bookkeeping.

Methodology and methods of reducing situational-matrix models' transformation to minimal (mathematical) form.

APPENDIX C
Schedule of Topics and Classes for Accounting Theory
Section 1: Accounting and Its Place in the Economic System

No. Section/ Topic	Name of the Section/Topic	Hours	Including		
		72	Lectures 36h	Tutorials 36h	Self-Study 74h
T 1	Aims, content, and structure of the course	4	2	2	2
T 2	Classification of assets	2	1	1	4
T 3	Financial processes and transactions	4	2	2	2

Section 2: The Subject and Aims of Accounting

No. Section/ Topic	Name of the Section/Topic	Hours	Including		
		72	Lectures 36h	Tutorials 36h	Self-Study 74h
T 1	Accounting: basic principles	2	1	1	2
T 2	Organization of accounting in the enterprise	4	2	2	2
T 3	Balance sheet and its meaning	4	2	2	2
T 4	The double-entry system	8	4	4	4
T 5	Accounts and the chart of accounts	2	1	1	2

Section 3: Modeling as a Means of Theory Development and Improving Methodology in Accounting

No. Section/ Topic	Name of the Section/Topic	Hours	Including		
		72	Lectures 36h	Tutorials 36h	Self-Study 74h
T 1	Standards and principles in accounting	2	1	1	2
T 2	Accounting as an object for mathematic modeling: status and prospects	2	1	1	4
T 3	Accounting and symmetry as a demonstration of financial transaction's double nature	2	1	1	4

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Appendix C (continued)

Section 4: Concept of the Accounting Information Equivalence and Its Transformation Algorithms

No. Section/ Topic	Name of the Section/Topic	Hours	Including		
		72	Lectures 36h	Tutorials 36h	Self-Study 74h
T 1	Theoretical bases of equivalence concept and its transformation algorithms	2	1	1	4
T 2	Equivalence of accounting transactions' syntactic forms and their logical-mathematical form	2	1	1	4
T 3	Classification and equivalence of accounting methods	2	1	1	4

Section 5: Accounting and Situational Modeling

No. Section/ Topic	Name of the Section/Topic	Hours	Including		
		72	Lectures 36h	Tutorials 36h	Self-Study 74h
T 1	Concept of the situational modeling as accounting language	2	1	1	4
T 2	Balance equations in accounting situational modeling systems	2	1	1	4
T 3	Methodological problems of situational modeling algorithmization	2	1	1	4
T 4	Some examples of situational modeling algorithmization in the field of accounting transactions	6	3	3	4

Section 6: Methodology and Methods of Constructing the System Matrix and Situation-Matrix Models in Accounting

No. Section/ Topic	Name of the Section/Topic	Hours	Including		
		72	Lectures 36h	Tutorials 36h	Self-Study 74h
T 1	Matrix model of chess-balance formation	4	2	2	4
T 2	Matrix model of accounting: from transactions to balance sheet	6	3	3	4
T 3	Pacioli's and Pizani's postulates: their proof in the proposed situation-matrix modeling system	4	2	2	4
T 4	Matrix models of dynamic ACL-equation (Active-Capital-Liabilities)	4	2	2	4