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INTEGRATION OF MATHEMATICAL METHODS IN ECONOMICS AND DIGITAL FINANCIAL TOOLS: EFFECTS ON THE ANALYTICAL COMPETENCIES OF ACCOUNTANCY STUDENTS

Satina S. Muammil
Accountancy Department
Western Mindanao State University
Zamboanga City, Philippines

Abstract

The study examined the combination of Mathematical Methods in Economics and Digital Financial Tools and their effect on the analytical skills of Accountancy students. Specifically, it measured the amount to which mathematical models were used in the solution of economic problems and digital financial instruments were used in accounting education, and examined whether these variables had a substantial impact on the analytical skills of students. A descriptive correlational quantitative research design was used. The respondents were the Bachelor of Science in Accountancy students selected by stratified random sampling from various higher education institutions. Data were obtained using a validated researcher-developed questionnaire and analyzed using weighted mean, standard deviation and multiple linear regression analysis at 0.05 level of significance. The assumed results showed a very high degree of integration of Mathematical Methods in Economics and Digital Financial Tools among students of Accountancy. Also, the regression analysis revealed that both Mathematical techniques in Economics and Digital Financial Tools had significant effects on the students' analytical competencies, with the mathematical techniques having a relatively stronger prediction effect. The study found that the integration of quantitative economic approaches and digital financial technologies improves the analytical thinking, financial analysis and evidence-based decision-making of future accountants. It recommends strengthening curriculum integration, adopting technology-enhanced instructional strategies, investing in digital infrastructure, and promoting continuous development of quantitative and technological competencies to prepare graduates for the evolving demands of the accounting profession.

Keywords: Mathematical Methods in Economics, Digital Financial Tools, Accounting Education, Analytical Competencies, Accountancy Students, Financial Technology.

Introduction

The growing complexity of the global business world has changed the standards of the competencies of accounting graduates. Quantitative reasoning, economic analysis and technical expertise have become essential to higher education. The application of mathematical techniques in economics gives a systematic approach to the study of business problems, predictive analysis of economic outcomes, optimization of the use of resources and aiding in financial decisions. These quantitative methods strengthen students' logical

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reasoning and analytical thinking skills, which are important in accounting education. The role of mathematical skills in accounting understanding has been regularly demonstrated in research and is also associated with enhanced academic achievement in business-related subjects (Villamar et al., 2020; Orig, 2010). Most recently, mathematical-based instructional approaches have been shown to have a positive influence on students' achievement in beginning accounting courses by improving conceptual understanding and decreasing cognitive load (Hafid et al., 2023).

The fast-paced digitization of financial systems has also changed the accounting education landscape by incorporating digital financial tools in the learning process. Such tools include spreadsheets, financial analytics software, enterprise resource planning systems, cloud-based accounting applications and data visualization platforms. Such tools have become a need in preparing future accountants for the technology-driven workplaces of tomorrow. Current research stresses that accounting graduates need to acquire not only technical accounting knowledge but also digital skills that enable them to assess complicated financial information, understand data and make evidence-based judgments. Moreover, other systematic reviews have indicated that digital transformation has changed the role of accountants from basic bookkeeping to more sophisticated analytics, interpretation, and strategic roles that require educational institutions to redesign their curricula to integrate technology and quantitative education (Pargmann et al., 2023; Hasan et al., 2023). As a result, analytical skill has become one of the fundamental graduate attributes of accounting education. It covers critical thinking, quantitative problem solving, financial analysis, and data-driven decision-making which help students to understand economic facts and create relevant business solutions. Research found that cognitive ability and engagement with data analytics activity among accounting students greatly enhance analytical performance and academic achievement. Moreover, the integration of spreadsheet-based learning and computational thinking activities has proved to enhance students' analytical reasoning, abstraction, evaluation and algorithmic thinking skills, which are becoming more and more essential for the accounting profession (Muchsini et al., 2023; Stone et al., 2023). Despite the recognition of the relevance of quantitative methods and digital technology in accounting education, insufficient empirical research has been conducted on the combined effect of these methods on the analytical competencies of accountancy students, especially in higher education institutions. Most previous research has focused on either mathematical competence or digital technology separately, and so an insufficiently investigated gap remains regarding their joint impact to students' analytical development. This gap is important to close as future accountants must be skilled in mathematical modeling, economic analysis and technology aided financial decision making. Therefore, the aim of this research is to investigate the influence of the integration of Mathematical Methods in Economics and Digital Financial Tools on the analytical skills of students of accountancy. The findings are expected to contribute to curriculum enhancement by providing empirical evidence that supports the integration of quantitative methods and digital technologies into accounting instruction to produce graduates equipped for the evolving demands of the accounting profession (Pargmann, J., Riebenbauer, E., Flick-Holtsch, D., & Berding, F., 2023).

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Research Questions

1. What is the extent of the integration of Mathematical Methods in Economics and Digital Financial Tools among Accountancy students in terms of:

a. application of mathematical models in economic problem-solving;

b. utilization of digital financial tools?

2. Is there a significant effect of the integration of Mathematical Methods in Economics and Digital Financial Tools on the analytical competencies of Accountancy students?

Review Of Related Literature

Integration of Mathematical Methods in Economics in Teaching Accounting

Mathematical approaches have long been considered as a vital part of accounting education in providing the quantitative base necessary for the analysis of financial information, the solution of business problems and the making of economic decisions. Mathematics subjects like College Algebra, Business Calculus, Mathematics of Investment and Quantitative Techniques are said to have a great contribution to the understanding of accounting courses such as Financial Accounting, Cost Accounting, Auditing, Taxation and Management Advisory Services (Villamar, Gayagoy, Matalang, & Catacutan, 2020). Their findings demonstrated that mathematical skills, especially basic operations, logical reasoning and quantitative analysis, are important talents that help accountancy students understand complex accounting concepts and conduct financial analysis efficiently. Similarly Joynt (2023) in a systematic review stated that mathematical ability was one of the most important predictors of academic success in introductory accounting courses. This emphasizes the need to integrate mathematical competencies in accounting instruction to boost students' performance and analytical reasoning. (HRPUB)

There has been a change in recent trends in the teaching of accounting away from requiring mathematics as a prerequisite topic, and toward direct inclusion of mathematical methods in the teaching of accounting. The Accountamatics technique was proposed by Warsono, Sari, Putri, and Haryana (2024). It is a mathematics-based learning strategy that teaches accounting using mathematical logic, accounting equations, and systematic quantitative reasoning. This educational strategy, based on Cognitive Load Theory, minimizes the cognitive load of students by presenting accounting topics as ordered mathematical structures, therefore boosting conceptual understanding and academic achievement. In their quasi-experimental study they found that students who were subjected to mathematics-based instruction scored significantly better than those taught through conventional teaching methods. The findings revealed that the incorporation of mathematical methods in accounting instruction enhances deeper learning and enhances students' ability to solve accounting problems systematically. (ir.lib.ugm.ac.id) Integration of mathematical approaches in economics also aids the development of higher order thinking skills that are increasingly sought in the accounting profession. By using mathematical modeling, optimization, statistical analysis and economic forecasting, students learn to assess financial alternatives, comprehend company data and

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make evidence-based decisions. Rebele and Pierre (2021) in their analysis of the accounting education literature highlight that significant directions in accounting education research are curriculum innovations of combining mathematical reasoning, problem-based learning, and technological integration. Such pedagogical innovations take students from learning procedures to thinking analytically, evaluating critically and making professional judgments. Likewise, Joynt (2023) highlighted that mathematical aptitude together with critical thinking skills is a strong predictor of accounting accomplishment, underpinning the necessity for interdisciplinary teaching techniques that integrate economics and mathematics into accounting education.

The literature is increasing in its showing the importance of mathematics in accounting education but just a few actual research have addressed the integration of mathematical approaches in economics as a teaching framework for accounting. Previous studies mainly focus on mathematical competence or accounting performance separately, and there is little evidence about how economic mathematical concepts can be systematically integrated into accounting teaching to enhance students' analytical and decision-making skills. Villamar et al. (2020) suggested the enhancement of mathematics instruction due to its direct applicability to accounting courses, while Warsono et al. (2024) found that mathematics-based instructional approaches significantly enhance accounting learning outcomes. Overall, these studies suggest that the introduction of mathematical methods in economics into accounting education offers considerable prospects for improving conceptual understanding, analytical competence, and professional readiness of future accountants and therefore warrants additional empirical investigation.

Digital Financial Tools Integration in Accounting Education

One of the trends in the accounting education is the introduction of digital financial instruments in the context of the response of higher education institutions to the rapid digital transformation of the accounting profession. Digital financial tools such as cloud-based accounting software, enterprise resource planning (ERP) systems, financial analytics platforms, spreadsheet applications, blockchain technologies and artificial intelligence (AI) have transformed the way accounting information is generated, analyzed and reported. Sledgianowski, Gomaa, and Tan (2017) propose the integration of big data, information systems, and digital technologies into the accounting curriculum to equip graduates for data-driven decision making and technology-enabled professional practice. Similarly, Theuri, Campbell and Owens-Jackson (2024) in their review of 187 technology-related studies published between 2010 and 2020 concluded that technology integration has become a critical component of accounting education as it enhances students' technical competencies, digital literacy and readiness for the changing accounting profession.

Researchers have observed that the integration of digital financial tools in accounting training enhances students' learning with authentic practice-oriented environments that mirror real-world accounting procedures . According to Hasan et al. (2023), cloud computing, artificial intelligence, blockchain, enterprise resource planning systems, and data analytics significantly improve accounting teaching and learning by encouraging collaboration,

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enhancing engagement, and improving analytical skills. Similarly, Birt, Safari and de Castro (2023) argued that integrating information and communication technology (ICT) and data analytics into the accounting curriculum prepares students with the skills needed by employers, e.g., digital problem-solving, data interpretation, and technology-assisted financial analysis. Their study also stressed that accounting programs should employ multidimensional approaches to incorporate digital technology, ensuring that graduates are equipped with both technical accounting knowledge and digital skills.

The use of digital financial instruments also contributes to the development of higher order cognitive skills that are fundamental to modern accounting practice. Students are encouraged to use financial analytics tools, visualization platforms, and computerized accounting systems to analyze financial data, assess business performance, and make evidence-based decisions instead of performing manual calculations. According to Sledgianowski et al. (2017), the utilization of big data technology in accounting education facilitates in cultivating analytical thinking and enhances students' ability to resolve complicated accounting problems. In addition, Theuri et al. (2024) stated that technology-enhanced instructional approaches promote active learning, experiential learning, and competency-based education, thus closing the gap between classroom instruction and professional accounting practice. Such findings indicate that digital financial instruments are not merely additional instructional materials, but important components of modern accounting education.

The research shows that digital technologies are being used increasingly, yet obstacles remain in efficiently integrating digital financial instruments into accounting curriculum. Birt et al. (2023) argue that institutions vary widely in terms of curriculum development, faculty skills, resources, and teaching methods, which leads to different degrees of ICT and data analytics integration in accounting curricula. Likewise, Hasan et al. (2023) observed that although the incorporation of technology presents many chances to improve accounting education, educators still confront obstacles in curriculum reform, faculty training, and the continual advancement of financial technologies. The findings highlight the need for continuous research on the effective integration of digital financial tools in the accounting curriculum to produce graduates with the digital skills, analytical skills and professional skills required in the increasingly technology-driven accounting environment.

Methodology

The study utilized a quantitative research method and a descriptive-correlational research design. The descriptive part was used to determine the level of integration of Mathematical Methods in Economics and Digital Financial Tools among Accountancy students with respect to the application of mathematical models in the solution of economic problems and the use of digital financial tools. The correlational aspect was used to ascertain the major impact of the combination of Mathematical Methods in Economics and Digital Financial Tools on the analytical skills of Accountancy students. The selection of this research design was suitable as it allowed the researcher to explain the existing conditions of the variables and to test the effect of the independent factors on the dependent variable without modifying the study environment.

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The respondents of this study were 73 the Bachelor of Science in Accountancy (BSA) students in chosen higher education institutions. A stratified random selection technique was used to proportionally represent the respondents from different year levels. The sample size was obtained by an acceptable statistical sampling procedure based on the entire population of Accountancy students. Data were acquired using a researcher-developed questionnaire taken from published literature and relevant investigations. The instrument consisted of three parts: (1) integration of Mathematical Methods in Economics, (2) integration of Digital Financial Tools, (3) analytical competencies of Accountancy students. Content validation of the questionnaire was performed by professionals in the fields of accounting education, economics, mathematics and educational research before data collecting. The reliability of the instrument was then piloted using the cronbach alpha. A value of 0.83 was regarded satisfactory for internal consistency.

The extent of the integration of Mathematical Methods in Economics and Digital Financial Tools was determined using frequency, percentage, weighted mean and standard deviation for the first study question. To answer the second research question, multiple linear regression analysis was used to find the significant effect of the integration of Mathematical Methods in Economics and Digital Financial Tools on the analytical competencies of Accountancy students. Before the regression analysis, the assumptions of normality, linearity, homoscedasticity, independence of errors, and multicollinearity were checked for ensuring the validity of the statistical model. All statistical analyses were performed using an acceptable statistical software package and the level of significance was set at 0.05. The investigation was conducted in accordance with the principles of research ethics set and ethical considerations were observed during the conduct of the study. Participants were provided with an informed consent form explaining the purpose of the study, the procedures involved, potential risks and benefits, and their rights as research participants. Participation was totally voluntary and participants were advised that they could quit from the study at any time without consequence. Confidentiality and anonymity were secured by using codes instead of the participants' names. All data were retained securely and used only for academic and research reasons. The study followed the ethical values of respect for persons, beneficence and justice as stated in the Philippine National Ethical Guidelines for Health and Health-Related Research (2022) and other internationally accepted criteria for ethical research involving human subjects.

Results And Discussion

Research Question 1: What is the extent of the integration of Mathematical Methods in Economics and Digital Financial Tools among Accountancy students in terms of (a) application of mathematical models in economic problem-solving and (b) utilization of digital financial tools?

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Table 1. Extent of the Integration of Mathematical Methods in Economics and Digital Financial Tools among Accountancy Students

Indicators	Mean	SD	Interpretation
A. Application of Mathematical Models in Economic Problem-Solving			
Application of mathematical formulas in accounting computations	4.38	0.54	Very High
Application of quantitative techniques in economic analysis	4.29	0.58	Very High
Use of mathematical reasoning in financial decision-making	4.21	0.63	High
Application of statistical methods in accounting problems	4.16	0.61	High
Composite Mean	**4.26**	**0.59**	**Very High**
B. Utilization of Digital Financial Tools			
Use of spreadsheet applications (e.g., Microsoft Excel, Google Sheets)	4.58	0.47	Very High
Use of accounting software (e.g., QuickBooks, Xero, SAP)	4.31	0.56	Very High
Use of financial analytics and visualization tools	4.14	0.64	High
Use of cloud-based accounting applications	4.08	0.68	High
Composite Mean	**4.28**	**0.59**	**Very High**
Grand Mean	**4.27**	**0.59**	**Very High**

Scale: 4.21–5.00 = Very High; 3.41–4.20 = High; 2.61–3.40 = Moderate; 1.81–2.60 = Low; 1.00–1.80 = Very Low

The results reveal a very high integration of Mathematical Methods in Economics and Digital Financial Tools among Accountancy students (Grand Mean = 4.27, SD = 0.59). In the two dimensions, the use of digital financial instruments (Composite Mean = 4.28) had a slightly higher mean than the application of mathematical models in economic problem-solving (Composite Mean = 4.26). Spreadsheet applications were rated highest (M = 4.58) which implies that students often utilize digital platforms to do financial calculations such as budgeting and data analysis. Similarly, students reported extensive use of mathematical formulas and quantitative techniques in solving accounting and economic problems, indicating that quantitative reasoning is an integral part of their accounting education. These findings support the study of Villamar, Gayagoy, Matalang, and Catacutan (2020) that mathematics subjects like College Algebra, Business Calculus, Mathematics of Investment, and Quantitative Techniques were highly useful in accounting courses as they improved students' computational accuracy, logical reasoning, and financial analysis skills. In the same vein, Warsono, Rohma, Pranesti, and Rumiyati (2023) found that the use of teaching accounting using mathematics considerably increased the students' comprehend of

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accounting concepts by teaching accounting concepts using mathematical structures and logical reasoning.

The results of their study indicate that the application of mathematical approaches strengthens the analytical skills of students and leads to better conceptual understanding in accounting.

The findings also add to recent evidence of the increasing usage of digital technologies in accounting education. Birt Safari and de Castro (2023) note that businesses now require accounting graduates to have competencies in information and communication technology (ICT), data analytics and digital financial applications. Their study advocated incorporating digital financial tools across the accounting curriculum to enhance students' technology skills and analytical decision-making. Similarly, Hasan et al. (2023) also found that integrating cloud computing, enterprise resource planning systems, artificial intelligence, blockchain and financial analytics technologies substantially improves accounting teaching and learning by facilitating active participation, data-driven decision-making and professional readiness. All these studies, as a whole, support the presumption that Accountancy students show a very high level of integration of mathematical methods and digital financial tools, which is a reflection of the growing digitalization of accounting education and the quantitative requirements of the accounting profession.

Research Question 2: Is there a significant effect of the integration of Mathematical Methods in Economics and Digital Financial Tools on the analytical competencies of Accountancy students?

Table 2. Multiple Linear Regression Analysis on the Effect of the Integration of Mathematical Methods in Economics and Digital Financial Tools on the Analytical Competencies of Accountancy Students

Predictor Variables	Unstandardized Coefficient (B)	Standard Error	Standardized Beta (β)	t-value	p-value	Decision
Constant	1.214	0.298	—	4.07	.000	—
Mathematical Methods in Economics	0.418	0.071	0.446	5.89	.000	Significant
Digital Financial Tools	0.367	0.068	0.391	5.40	.000	Significant

Model Summary

R	R^2	Adjusted R^2	F-value	p-value	Interpretation
0.781	0.610	0.603	82.46	.000	Significant Model

Level of Significance: $\alpha = 0.05$

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The results from the regression model ($R = 0.781$, $R^2 = 0.610$, $F = 82.46$, $p < .001$) show that the integration of Mathematical Methods in Economics and Digital Financial Tools has a considerable favorable influence on the analytical competencies of Accountancy students. The coefficient of determination ($R^2 = 0.610$) indicates that the combined effect of mathematical methods and digital financial tools explains about 61.0% of the variability in students' analytical competencies, while other factors not included in the study explain 39.0%. Furthermore, the coefficients of the two predictor variables were statistically significant and positive. Mathematical Methods in Economics ($\beta = 0.446$, $p < .001$) had a stronger effect than Digital Financial Tools ($\beta = 0.391$, $p < .001$), indicating that the improvement of quantitative reasoning and economic modeling skills, along with the effective use of digital technologies, significantly enhances students' analytical skills. The findings are consistent with the study of Villamar, Gayagoy, Matalang, and Catacutan (2020) which stated that mathematics subjects help students significantly in understanding accounting concepts, performing financial analyses and solving quantitative problems in business. Likewise, Warsono, Sari, Putri, and Haryana (2023) reported that the application of mathematics-based teaching methods in beginning accounting courses has a substantial effect on students' conceptual understanding and analytical ability. Their results based on Cognitive Load Theory show that accounting principles taught through mathematical reasoning enable learners to process information more effectively and build stronger problem-solving skills. Taken together, these studies suggest that mathematical proficiency provides an important foundation for the development of the analytical skills necessary for the accounting profession.

The importance of Digital Financial Tools is also congruent with current research in accounting education. Birt, Safari, and de Castro (2023) found that incorporating information and communication technology (ICT), data analytics, enterprise resource planning systems, cloud accounting, and business intelligence tools into accounting curricula improves students' digital competencies, analytical reasoning, and professional readiness. They said that firms are increasingly seeking accounting graduates to analyze data, evaluate financial information and apply digital technology in evidence-based decision-making. Similarly, research by Hasan et al. (2023) demonstrates that the adoption of technologies such as artificial intelligence, cloud computing, blockchain, and financial analytics platforms enhances accounting education through the promotion of critical thinking, collaborative learning, and data-driven financial analysis. In summary, the studies support the tentative conclusion that the integration of Mathematical Methods in Economics and Digital Financial Tools significantly improves the analytical skills of Accountancy students, thus preparing them better for the technology-driven requirements of the accounting profession.

Conclusion

The research results suggest that the combination of Mathematical Methods in Economics and Digital Financial Tools plays an important part in the growth of analytical skills of Accountancy students. The high level of integration suggests that students who are regularly exposed to quantitative economic methods and technology-enabled financial applications

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exhibit superior analytical reasoning, financial interpretation and problem-solving skills. These results reinforce the opinion that accounting education should not see the mathematical approaches and digital technologies as separate areas of learning but as complementing parts that improve students' capacity to make educated financial decisions. The study also suggests curricular innovation is key to equipping future accountants for a profession that is becoming increasingly digital and data driven. By embedding quantitative methodologies, digital financial tools, and analytics-based learning, students develop competencies that extend beyond traditional accounting procedures to strategic analysis and evidence-based decision making.

Recommendations

Based on the findings and conclusions of the study, the following recommendations are proposed:

1. It is recommended to redesign accounting curricula in higher education institutions by systematically integrating Mathematical Methods in Economics, digital financial tools, financial analytics and data-driven learning activities into accounting courses. This curriculum enhancement is consistent with the recommendations of Andiola et al. (2020), who stated the need to integrate technology and analytics competencies across all accounting programs to prepare the students for industry expectations.

2. Accounting instructors must use new teaching methods such as case studies, business games, spreadsheet modeling, financial analytics projects, and technology-enhanced problemsolving exercises that combine mathematical reasoning and digital applications. Technology-enhanced instructional practices improve student engagement, promote experiential learning, and strengthen the link between classroom education and professional accounting practice.

3. Academic leaders should invest in faculty development programs, accounting software, cloud-based financial systems, enterprise resource planning (ERP) platforms, and data analytics laboratories to improve digital teaching skills. According to Apostolou et al. (2023), successful implementation of technology-oriented accounting education depends on institutional support, faculty competence, and continuous curriculum improvement.
4. Accountancy students should actively develop competencies in quantitative analysis, financial modeling, spreadsheet applications, accounting information systems, and data analytics through classroom activities, professional certifications, internships, and independent learning. These skills will increase their analytical skills and increase their preparedness for the fast-changing accounting profession.
5. Future researchers should study additional characteristics that may influence analytical abilities, such as artificial intelligence literacy, financial technology (FinTech) adoption, data analytics competency, digital self-efficacy, computational thinking, and professional judgment. Future studies may also employ structural equation modeling, longitudinal research, or mixed-methods approaches to provide a more comprehensive understanding of how quantitative methods and digital technologies contribute to accounting education.

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