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Integrating Video Barcode Technology In Multimedia Spreadsheet Textbooks: A Modern Approach To Teaching Corporate Financial Statements

Original Article

Irwan Adimas Ganda Saputra[1*],Vivi Pratiwi[2], Eka hendi Andriansyah[3], Suci Rohayati[4], Ni Nyoman Alit Triani[5], Amanda Dwi Kurnia[6], Aldi Saputro[7], Aprillia Nilasari[8]
[1*,2,4,6,7,8]Department of Accounting Education, Universitas Negeri Surabaya, Indonesia
[3]Department of Economics Education, Universitas Negeri Surabaya, Indonesia
[5]Department of Accounting, Universitas Negeri Surabaya, Indonesia
Email: [1*]) irwansaputra@unesa.ac.id

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Abstract

In education, digital transformation is accompanied by the need for new teaching media innovations to address the challenges of inadequate technical skills among accounting education students, particularly regarding the use of spreadsheets for financial statement preparation. This study aims to develop class multimedia textbooks in the form of spreadsheets integrated with QR Code videos and test their validity, practicality, and effectiveness in enhancing student understanding and skills. This utilizes a Research and Development (R&D) approach with the ADDIE model, which consists of analysis, design, development, implementation, and evaluation. The product was developed with text and visualization, supplemented by video tutorials accessed through QR Codes to enrich the learning experience. The textbooks were determined to have a very high level of purported validity through expert validation. Significant classroom implementation showed strong positive effects on student learning outcomes alongside positive perceptions toward ease of use and effectiveness. This research enriches the literature on the development of technological learning media in accounting education and demonstrates innovation in integrating print and digital media. Furthermore, this innovation supports the achievement of Sustainable Development Goal (SDG) 4, which aims for high-quality, inclusive, and adaptable education in the context of the 4th Industrial Revolution (IR 4.0).

Keywords: Accounting Spreadsheet, ADDIE Model, Digital Learning, Multimedia Textbook, QR Code, SDG 4

1. Introduction

Indonesia and other developing nations are facing unprecedented challenges and new opportunities due to the digital transformation in education. The 4.0 Industrial Revolution and the Society 5.0 era have spotlighted mastering digital literacy and practical technology skills as essential for fostering highly qualified graduates competent in today's workforce (Zahidi, 2024). Unfortunately, a considerable portion of Indonesia's higher educational institutions, particularly accounting education study programs, still heavily utilize traditional methodologies that emphasize theoretical instruction, limited practical engagement, and a negligible integration of digital resources (Al-Hattami, 2025; Coovadia & Ackermann, 2021; Tettamanzi et al., 2023). As a result, students' technical skills remain insufficient, such as using spreadsheets to prepare corporate financial statements—a critical modern accounting competency (Bradbard et al., 2014; Peters & Chiu, 2022).

The need to develop new teaching tools incorporating technology becomes more evident in this scenario. One of the solutions could be creating multimedia-based textbooks and integrating videos with QR codes. Creating such aids can synergize practice and theory while catering to the learning preferences of students from the digital-native generation, who appreciate visual materials and content accessed dynamically and flexibly (W. Ahmed & Zaneldin, 2020; Mayer, 2020). QR codes enable the integration of print and online materials, allowing students to access tutorial videos on preparing financial statements through mobile phones and other digital devices without relying on face-to-face sessions. Prior research demonstrates that QR Code video integration enhances student engagement, information retention, and skills practice in technical learning environments (Karia et al., 2019; Minard, 2024; Tsoukala et al., 2024).

The novelty of this research stems from the culmination of three distinct endeavours, including (1) the creation of an accounting textbook with integrated spreadsheets, (2) the incorporation of video resources through QR codes within the textbook's structure, and (3) the systematic application of a Research and Development (R&D) approach based on the 4D model of Define, Design, Develop, and Disseminate. Focused primarily on creating digital media, many previous studies ignored hybrid solutions, using exclusively online modules for the print-less integration with printed media (AlShaikh et al., 2024; Deng & Yi, 2025; Li et al., 2025; Willis, 2016). This research aims to fill the gap in creating integrated teaching media applicable to online, offline, and hybrid learning environments. Moreover, it expands the use of principles of experiential learning (Kolb, 2014) and multimedia learning (Mayer, 2020) in accounting education, which has, in the context of Indonesia, underperformed comprehensively.

At this stage, this innovation corresponds to the national and international policy considerations with the Independent Campus policy of the Ministry of Education, Culture, Research and Technology, which advocates for creating a practice-oriented curriculum, digital literacy, and 21st-century skills. More broadly, the development of multimedia textbooks is directed toward the Sustainable Development Goals (SDGs) movement, particularly Goal 4, which focuses on education and the achievement of quality education and promotes lifelong learning opportunities (UNESCO, 2022). Therefore, this research is strategically important in strengthening higher education in Indonesia

From the description above, the problem formulations in this study are: (1) What is the development process of creating multimedia-based textbooks on spreadsheets that integrate QR Code video tutorials in terms of validity, practicality, and effectiveness for learning company financial statements? (2) What is the practicality and effectiveness of the developed textbooks regarding students' understanding and skills? (3) How do video-based QR Code textbooks affect learners' engagement and outcomes in accounting subjects? This study aims to accomplish the following: (1) Design and develop accounting textbooks on spreadsheets integrating QR Code video tutorials using an R&D approach; (2) assess the textbooks' effectiveness in enhancing learners' understanding and skills; (3) analyze learners' motivation, active participation, and academic performance post-intervention.

This research offers vital practical and theoretical insights. This research assists in filling the gap in the literature on technology integration into instruction in accounting education programs, particularly concerning automated spreadsheets. Such media can be designed for use in diverse fields to improve instruction and serve as an adaptive and flexible teaching aid in support of learning at numerous universities. The research done here is hoped to address the issues posed by the digital transformation of education at the tertiary level in Indonesia and assist in the crafting of a learning system that is more efficient and effective than before.

2. Literature Review

2.1. A Spreadsheet Textbook for Teaching Accounting

School textbooks are the foremost educational materials since they foster a systematic approach to acquiring knowledge. In accounting education, the application of spreadsheet textbooks like Microsoft Excel or Google Sheets has been developed as an innovation to enhance students' technical skills. Besides being a computation tool, spreadsheets act as a means through which a student can internalize and apply the accounting cycle – from journaling to the preparation of financial statements – conceptually (Al-Hattami, 2025; Bavaresco et al., 2023; Willis, 2016). The primary merit of textbook supplements based on spreadsheets is their capacity to unify theory and practical work. Students can actively work with financial data, journalize transactions, and subsequently transfer them to the ledger from which they can construct a balance sheet and other financial statements. This method enhances deeper and more meaningful learning (Andiola et al., 2020; Borthick & Schneider, 2023). Command of spreadsheets is an in-demand competency in today's workplaces; thus, instruction with this tool is beneficial in preparing students for the professional world (Abdo-Salloum & Al-Mousawi, 2025; Tiron-Tudor et al., 2025; Wang et al., 2024). Moreover, using spreadsheets develops logical reasoning, problem-solving, and data-driven decision-making skills. This is connected to 21st-century competencies, wherein students are required, in addition to understanding theory, to be able to evaluate and synthesize information (Abdo-Salloum & Al-Mousawi, 2025; Borthick & Schneider, 2023; van Borkulo et al., 2023).

2.2. Understanding Multimedia Learning Theory as it Applies to Textbooks

According to Mayer (2020), Multimedia Learning Theory, combining pieces of learners' texts with accounting data visuals, workflows, captures, and integrates document interactions, and screenshots of spreadsheets, enhances retention. Learning is "best achieved" when content requiring jargon to describe is supplemented with imagery and narration. The human brain takes in and processes data through two significant channels; information can be received visually through images, graphics, or videos, and verbally through text or narration. Using both channels simultaneously is conducive to effective learning as it promotes more profound understanding and advanced conceptual comprehension and aids in retention over an extended period (Greer et al., 2013; Mayer & Moreno, 2020). Within the development of textbooks, it is important to ease the cognitive load on learners, which is achieved by reducing complex processes that can only be explained in the form of spoken words through screenshots and other visual aids. Including barcodes that link to videos and animations helps students learn the procedures for preparing financial statements step-by-step. Students learn more effectively with multimedia. Multimedia has also increased engagement among the students participating in a given activity (Heidig et al., 2015; Plass et al., 2014; Rodrigues & Silva, 2022). Students gain understanding through animated and interactive textbooks and a more enjoyable, stimulating, authentic, and goal-oriented learning environment, which is significant in sustaining motivation while fostering self-directed learning.

2.3. Employing Video Barcodes as an Advancement in Textbooks

Incorporating video barcodes or QR codes into textbooks epitomizes the convergence of print and digital media. With this innovation, students can unlock pertinent videos of their studies by scanning the barcode with their mobile devices. This tactic promotes autonomous learning and enables students to revisit the material as dictated by their learning rhythms

(Abdul Rabu et al., 2019; AlNajdi, 2022). QR codes also solidify just-in-time learning, providing explanatory videos for immediate viewing when students encounter test material. This feature is handy concerning the mechanics of journals, ledgers, and financial statements. In this manner, students follow the steps in the text and observe the steps being carried out (Alalwan et al., 2020). In addition, video barcodes allow content to be packaged and delivered as tutorials, case-study videos, accounting animations, and even recorded lectures. This helps diversify the learning experience and enhances ease of access. This method aids the inclusivity and diversity of student learning through the universal learning design (UDL) framework (Rose et al., 2013).

2.4. Sustainable Development Goals (SDGs) 4 and Its Contribution

The United Nations' goals not only focus on education but also highlight the need for it to be of higher quality through fairness and inclusivity under Sustainable Development Goal four. Reaching everything set under SDG 4, especially regarding the improvement of the educational conditions and opportunities and the quality of the learning offered in the institution, in particular the integration of technology in its appropriate form, which includes the development of textbooks based on technology, multimedia, and QR codes (United Nations Educational, Scientific and Cultural Organization (UNESCO, 2022). Changing conventional textbooks to digital ones and other forms of interactive learning media augments learning efficiency and universalizes learning opportunities to students regardless of their social class. Such integration provides flexible, adaptive, and approachable learning at any time and place, which is important in the context of dynamic and future-oriented higher education (Leite, 2022; Reimers, 2024). Therefore, the multimedia spreadsheet textbooks and video barcodes help in the technical and pedagogical improvement of accounting learning and contribute towards the global expectation of nurturing a sustainable, inclusive, and competitive education system.

3. Methods

The study was conducted using a Research and Development (R&D) framework, aiming to devise and evaluate an innovative product, which is a multimedia textbook with a video barcode. This product was designed for the Number Processing Programme course to enhance students' understanding and competencies. This course forms a part of the curriculum for digital accounting education. The R&D approach is relevant to ensure practical, systematic learning tools that respond to current needs (Gall et al., 2003; Van den Akker et al., 2013). In higher education, this approach also aligns with the intent to achieve SDG 4: Quality Education, which focuses on strengthening the quality and access to inclusive education that uses technology (UNESCO, 2022).

This research focuses on interactive teaching texts, including written material, visuals, and practical videos connected via QR barcodes. This coursebook is created with a contemporary instructional design approach that adheres to the multimedia learning theory (Mayer, 2020) and aims to facilitate the acquisition of digital skills using spreadsheets for financial statement preparation. The textbook encompasses the following topics: an overview of spreadsheet software, the preparation of income statements and balance sheets, and accounting simulations.

Research Subjects

The study participants were S1 Accounting students who attended a Spreadsheet course at one of the public universities in Indonesia. The sampling is combined with selection clauses about these criteria: (1) students who are in their second year, have completed an introductory course in accounting, (2) possess some knowledge of Excel or Google Sheets, and (3) routinely engage in both face-to-face and remote classes. Around 40 students from the other cohorts participated in the evaluation and production feedback processes. The Number Processing Programme course continues to play an important part in developing the digital skills of accountants. R. Ahmed (2008) views that "spreadsheet literacy is an accounting graduate's competency prerequisite to industrial era 4.0 and financial automation.".

ADDIE: A Developmental Process Model

In order to achieve systematic and needs-based development, this research adopted the ADDIE instructional development model, which consists of analysis, design, development, implementation, and evaluation. This model was chosen as it is iterative and adaptive, and has seen wide use in technology learning design research. (Branch, 2009; Molenda, 2015). Below is an in-depth description of each stage:

Insights through Educational Technology

This formative analysis determines the gaps within learning, the complexity of the Number Processing Programme course as a problem area, and the opportunities technology might offer to assist learning. Data was collected through interviews with the lecturers, learning needs questionnaires sent to students, and the analysis of the course syllabus. As for the results obtained from the survey administered to 25 fourth-semester students who have taken the Number Processing Program course, it is evident that most students face challenges in executing financial report generation digitally, especially during the construction of auxiliary ledgers, financial statements, and closing journals. From the interviews, students also expressed that the learning media offered is overly restricted due to being limited only to printed modules and live demonstrations of teaching sessions. The majority of students responded that they are more than willing to use interactive instructional media such as video guides so that the books can be used to augment their grasp of the ideas and make sense of practical processes. The Number Processing Program course syllabus focuses on the articulated accounting cycle of service and trading companies on spreadsheets. Students are expected to operate the software, prepare journals, ledgers, and balance sheets, and even write financial statements regarding learning outcomes. The traditional instructional strategy has not fully encouraged self-directed or multimedia learning. The highly procedural material is easier for students to grasp with a visual and demonstrative approach. This syllabus can still be enhanced with digital textbooks that foster technology-supported learning, corresponding to the 21st-century skills framework and SDG 4 (quality education). Furthermore, from the interviews conducted with the lecturers, the most striking issue regarding the instruction of this course is the disparity between students' grasp of accounting concepts and their systematic technical proficiency with spreadsheets. A significant portion of students tend to be passive and have a difficult time mastering practical tasks without guidance. The instructor has been enthusiastic about the proposal to create textbooks with advanced multimedia components, affirming that the materials would offer more enriched visual and flexible learning. Especially with the QR Code video in each chapter, students can access the guide directly as per their requirements. The lecturers highlighted the technology-enhanced learning environment's capability to integrate accounting theory with digital application, which Media

unifies accounting concepts and digital practice as a whole, enhances immersion, and transforms active learning. As AlShaikh et al. (2024) Claimed, using interactive videos fosters engagement and motivation and offers unique opportunities in remote learning environments of digital accounting education.

Design (Product Design)

During the Number Processing Programme, the product design phase starts with creating a structure and compiling the contents of the course multimedia textbooks. This textbook is intended to be a medium for organized contextual learning in which text, graphics, and video are integrated through Video Learning via QR Code technology. The design must follow a microlearning and just-in-time learning structure, which focuses on when and how the students wish to access the material and adapt to their needs. (Karia et al., 2019; Mayer, 2020). He self-study book content in the sequentially systematized content structure begins with teaching the learners to process accounting data until the preparation of financial statements and the closing of the books. The arrangement of the content in the textbook consists of:

1. Introduction – Presents the learning outcomes, which are the objectives of the self-study book, and competencies to be developed alongside the instructions on navigating the book and its features, including the interactivity/within the book.
2. Chapter 1: Set Up Database - Deals with the initial steps in setting up the company data and the work file in the spreadsheet application.
3. Chapter 2: Prepare Journal - Focuses on preparing a digital journal of transactions based on accepted bookkeeping standards.
4. Chapter 3: Creating Auxiliary Codes- Explains work on account codes for transaction grouping and report tracking.
5. Chapter 4: Compiling General Ledger- Policies on moving journals to the general ledger with integrated journaling.
6. Chapter 5: Compiling Subordinate Ledgers of Payables and Receivables- A complete construction of control instruments.
7. Chapter 6: Preparing the Balance Sheet- Procedures for constructing the worksheet or balance sheet that serves as a bank statement for the financial statements.
8. Chapter 7: Prepare Income Statement- Assist students in preparing an income statement based on the balance sheet data.
9. Chapter 8: Prepare Statement of Changes in Equity and Statement of Financial Position- Post accounting cycle advanced report writing.
10. Chapter 9: Prepare a Closing Journal- Introduce the rationale and mechanics of closing accounts for a given period.
11. Chapter 10: Compiling the Post-Closing Balance Sheet- Construction of the post-closing journal balance sheet as a final check.
12. Chapter 11: Creating a Menu Bar- Creating interactive menus to enhance movement within the spreadsheet and automate accounting tasks.
13. Practice Problems - Includes context-specific problems and case studies to sharpen critical thinking and problem-solving abilities.
14. Glossary - Compilation of important words that assist learners in understanding digital technology and accounting.
15. Index - An aid for self-study that enables a quick search of identified words and subjects in the textbook.

Every chapter is accompanied by a QR code that connects to a learning video whose duration appropriately corresponds to the complexity of the material within the respective chapter. The videos utilize microlearning techniques aligned with a learning-by-doing approach, demonstrating practical spreadsheet-use applications. The QR code is placed at the end of the chapter so that students can access the visual explanation without shifting to other resources. Through this method, students not only comprehend the theory read but also can view the steps involved in the digital accounting practice—conducting it as many times as they wish—according to the principle of self-paced learning. This design corresponds with AlNajdi's (2022 Findings, in which he emphasized that integrating text and animated videos within textbooks enhances students' engagement, understanding, and academic performance in learning technologies environments..

Development and Initial Validation

This phase involves drafting educational content such as text, exercises, and videos, creating QR codes linked to the YouTube Unlisted video platform, and embedding them into textbooks. After the initial product is ready, validation is performed by the accounting material experts, along with some limited trials on small groups of students. The validation approach employs a Likert-based rubric that evaluates aspects of conformity with harmonized learning objectives, scientific correctness and precision, completeness and adequacy of materials, language presentation and writing, style of the text, consistency and coherence of inter-chapters, as well as instructional design creativity, inclusive of multimedia utilization. (BNSP, 2021; Rodrigues & Silva, 2022). This product is classified as 'very feasible' based on the validation results, with minor revisions recommended. Based on Reeves (2006) Insights, the participation of experts at this stage is critical to enhance the instructional design and overall quality of the product before wider use—delayed Table 1 validation rubric for material experts.

Table 1. Material Expert Validation Rubric

No	Indicators	Questions
1	Conformity with Learning Outcomes	The material is based on the learning outcomes of the course.
		The material supports the development of students' digital accounting skills.
		Each chapter is logically connected to competency indicators.
2	Scientific truth and accuracy	Accounting concepts and theories are presented correctly.
		The information in the book is free from scientific errors.
		The technical procedures for using spreadsheets are based on digital accounting practices.
3	Completeness and Sufficiency of Material	The entire accounting cycle is discussed well (from journals to financial statements).
		The book includes practice questions and case studies.
		A glossary and index are available to facilitate understanding.
4	Presentation of Language and Writing Style	The language is easy to understand and communicative.
		Sentences are effective and abide by EYD rules.
		Technical accounting terms are used consistently.
5	Consistency and Coherence Between Chapters	The structure between chapters supports each other and forms a logical flow.
		The writing format is uniform between parts of the book.

		Each part (objectives, materials, exercises) is arranged consistently.
6	Learning Innovation and Multimedia Integration	The textbook uses a QR Code to access learning videos.
		Videos support the understanding of concepts visually and practically.
		Multimedia integration is by developments in educational technology.
		Textbook innovation supports independent and flexible learning.
		The video QR Code is placed strategically and functionally.

Source: BNSP (2021); BSNP, 2021; Reigeluth (2016)

Product Implementation in Real Classroom Contexts

The product is implemented with students throughout four lectures within a given month. The implementation is done with a blended learning framework where students learn independently using the provided textbooks and videos, and later discuss the concepts during class meetings (synchronous). As in all other cases, the process starts with the orientation with textbooks, which is always accompanied by an initial evaluation (pretest) to gauge students' understanding of number processing before instruction. During the implementation, participatory observations capture all forms of individual and group assignments, and documentation of student learning activities is also compiled. This method enables students to simultaneously evaluate their process and context performance, as in product evaluation. McKenney and Reeves (2018) See it..

Evaluation (Formative and Summative Evaluation)

The evaluation stage comprises two processes: formative evaluation and summative evaluation. Formative evaluation is done in the early stages, or alongside implementation, to ensure the end product is valuable. Summative evaluation is done to assess the overall effectiveness of the product and its contributions towards improving learning outcomes. The evaluation is conducted in the following ways:

- Through pre- and post-evaluation tests to ascertain understanding and skill level changes.
- Through students' perception surveys on the textbook's ease of use, clarity, and overall value.
- Through N-Gain analysis to assess the effectiveness of learning interventions.
- By calculating paired t-tests to determine the significance of realizing the set goals post-intervention.

Hake (1999) Cites that the N-Gain analysis effectively establishes the relative efficiency of a method of instruction about the change in learning outcomes.

4. Results and Discussion

Validation of the Material Experts

The results from Table 2 indicate that the multimedia spreadsheet textbook with integrated video barcodes is graded as very feasible. This means that from the perspective of the material and technology components, media of learning can be conceivably applied in the Digital Accounting course under the Accounting Education Study Program. The experts have assessed two accounting education expert lecturers serving as validators. They utilized a Likert scale instrument, which is set on ranges one to five in the sixth core components of congruence to the learning outcome, scientific validity and accuracy, material scope and depth, language and writing style, inter-chapter logical flows and writing coherence, and multimedia integration innovation into the rational pedagogic framework. The average score of 4.63 on the 5 Scale proves that high professional and educational standards have been achieved.

The first element, alignment with learning outcomes, achieved an average rating of 4.67. This demonstrates that the material is comprehensively structured and aligns with the Number Processing Program course's core competencies, particularly in nurturing accounting students' digital technical skills. Abdo-Salloum and Al-Mousawi (2025) corroborated this, stressing the importance of integrating technological literacy and digital competencies into the curriculum to equip students for the 21st century adequately... Abdo-Salloum and Al-Mousawi (2025) emphasize the importance of integrating technological literacy and digital competencies into the curriculum to prepare students for the reality of artificial intelligence and automation in professional accounting practice. Regarding scientific truth and accuracy, an average score of 4.61 indicates that the accounting concepts and the technical processes for operating spreadsheets have been thematized correctly and without gross errors. The precision of information is important to avoid conceptual fallacies and preserve the scientific honesty needed in the practice-based learning processes. (Al-Hattami, 2025).

Table 2. Results of Expert Validation of Multimedia-Based Spreadsheet Textbook Material

No.	Indicators	Questions	Average Category Score	Average Category Score
1	Conformity with Learning Outcomes	The material is based on the learning outcomes of the course.	4,67	Very Worth It
		The material supports the development of students' digital accounting skills.		
		Each chapter is logically connected to competency indicators.		
2	Scientific truth and accuracy	Accounting concepts and theories are presented correctly.	4,61	Very Worth It
		The information in the book is free from scientific errors.		
		The technical procedures for using spreadsheets are based on digital accounting practices.		
3	Completeness and Sufficiency of Material	The entire accounting cycle is discussed well (from journals to financial statements).	4,61	Very Worth It
		The book includes practice questions and case studies.		

		A glossary and index are available to facilitate understanding.		
4	Presentation of Language and Writing Style	The language is easy to understand and communicative.	4,58	Very Worth It
		Sentences are effective and abide by EYD rules.		
		Technical accounting terms are used consistently.		
5	Consistency and Coherence Between Chapters	The structure between chapters supports each other and forms a logical flow.	4,56	Very Worth It
		The writing format is uniform between parts of the book.		
		Each part (objectives, materials, exercises) is arranged consistently.		
6	Learning Innovation and Multimedia Integration	The textbook uses a QR Code to access learning videos.	4,73	Very Worth It
		Videos support the understanding of concepts visually and practically.		
		Multimedia integration is by developments in educational technology.		
		Textbook innovation supports independent and flexible learning.		
		The video QR Code is placed strategically and functionally.		

Source: processed by researchers

Moreover, Table 2 states that the completeness and sufficiency of the material score was 4.61, which means that all the steps in the accounting cycle have been performed in order: journaling, ledger entries, creating trial balances, and preparing financial statements. The textbook is supported as a learning resource with practical questions, a glossary, and an index that facilitate independent learning. (Deng & Yi, 2025). Regarding writing and language presentation, 4.58 ascribed indicates that the narration within the textbook is formulated in a communicative fashion that adheres to the standard Indonesian language norms and is uniform in the employment of scientific words or phrases. The language must be simple, especially when learners study self-paced (Mayer & Moreno, 2020). In addition, the assessment of the unity and wholeness of various chapters is as high as 4.56, which means there is a logical progression in the arrangement of the book's contents. Therefore, the flow is sequential and systematic. This cohesiveness enhances students' thinking continuity when learning intricate procedural materials like accounting cycles in spreadsheets.

The final component that received the highest weight was learning innovation and multimedia integration at 4.73. As per the validation, great value was given to implementing QR codes within textbooks and guiding students to video self-instructional materials using a microlearning strategy. QR codes are highly effective in promoting self-paced study, leading to heightened student engagement and flexible retrieval of supplementary materials and visual materials. (Minard, 2024). This supports the Multimedia Learning Theory principles. (Mayer, 2020), which states that using visual and auditory technology information systems, learning should be done at the same time because it enhances the understanding and retention of information;">This is in alignment with Multimedia Learning Theory (Mayer, 2020), which asserts that within technology information systems learning, the use of visuals and audio must

occur concurrently for optimal comprehension and retention of information, thus enhancing the learner's cognitive processing of the content. Therefore, these validation results give strong empirical evidence that the developed textbook products are of high instructional quality and appropriate for 21st-century learning. This media responds to the challenges of education digitalization and aligns with the Education Sustainable Development Goals (SDGs) 4, particularly in advancing inclusive and technology-enhanced quality education.

Pre-test and Post-test Analysis

To assess the advancement of students' comprehension and proficiency in using accounting spreadsheets, an evaluation was done with a pre-test as an intervention and a post-test after the intervention, which used video QR Code integrated multimedia textbooks. The results of the analysis of students' pre-test and post-test scores are provided below:

Table 3. Average Pre-test and Post-test Scores of Students

No	Test Type	Average Score	Description
1	Pre-test	62,15	Before intervention
2	Post-test	84,5	After intervention
3	Improvement	22,35	Difference in scores

Source: processed by researchers

The data in Table 1 shows that the average student score increased by 22.35 points after participation in a learning intervention using multimedia-based textbooks. The higher average post-test score suggests that the students improved considerably in grasping the material and the operational skills of preparing financial reports via spreadsheets. This change in score demonstrates that integrating video QR Codes into multimedia-based teaching aids positively enhances the students' learning outcomes. These findings reinforce the hypothesis that innovative teaching aids enrich the learner's experience, enhance a learner's active participation, and foster self-directed learning as appropriate to modern approaches to instruction and education in the 21st Century.

Analyzing the Perception of Students Towards Textbooks

The perception survey was conducted on 4th-semester students of the Accounting Education Study Program who utilized textbooks during their university study period. Respondents were requested to give evaluations about the content, structure, multimedia, motivational, and skill enhancement the textbook has on them, using a Likert scale of 1 to 5. The recapitulation results of 42 respondents in Table 4 reveal that student perceptions were mainly positive, with the average score of all statements surpassing 3.9 and several components attaining 4.3 and above. The statement with the highest score was "The QR Code in the book is easy to access using a smartphone," scoring 4.36. This suggests that the integration of digital media through QR Codes is perceived as very practical and functional. This agrees with Minard (2024) A study remarked that access to QR codes increases efficiency and engagement in multimedia learning.

Attendance scored 4.31 on "The material in the textbook is by the lecture material," "I feel helped by the visual explanations in the video," and "The use of multimedia," which demonstrates that students appreciate the integration of video tutorials about visual content, which, in turn, aids understanding and motivation. Increased comprehension and motivation are aligned with Mayer and Moreno (2020) The assertion that the use of visuals with verbal presentation of information aids significantly in the learning process and information retention. Students also appreciated their independence in learning, exhibited in their rating

of 4.26 for the statement: "This book can be used independently outside of the lecture hours." This indicates that the textbook was designed to foster autonomous learning, aligning with the self-paced learning principles and just-in-time teaching model posited by AlNajdi (2022).

Table 4. Student Perceptions of Multimedia-Based Textbooks

No.	Statement	Average Score	Category
1	The QR Code in the book is easily accessible using a smartphone	4.36	Strongly Agree
2	The material in the textbook is the lecture material of the Number Processing Program	4.31	Strongly Agree
3	I feel helped by the visual explanation in the video	4.31	Strongly Agree
4	The use of multimedia makes learning more interesting	4.31	Strongly Agree
5	This book can be used independently outside of class hours	4.26	Strongly Agree
6	This textbook helps me improve my spreadsheet skills	4.24	Strongly Agree
7	The contents of the book are easy to understand and presented sequentially	4.21	Strongly Agree
8	The videos displayed via QR Code are relevant to the contents of the chapter	4.21	Strongly Agree
9	I want other teaching materials that use this approach	4.19	Agree
10	The book covers the entire cycle of preparing financial reports	4.17	Agree
11	Examples and practice questions help me understand the material	4.07	Agree
12	This textbook makes me more motivated to learn digital accounting	4.07	Agree
13	I am more confident in preparing financial reports after using this book	3.93	Agree
14	I feel actively involved when studying the material from this book	3.90	Agree

Source: processed by researchers

Moreover, a score of 4.24 on the statement "This textbook helps me improve my spreadsheet skills" demonstrates that this media aids comprehensive understanding and enhances students' practical skills and technical competencies. While the overall reporting results were indeed very positive, there are several items with somewhat lower scores yet still considered satisfactory, for instance, "I feel actively involved when studying the material from this book." (3.90) and "I am more confident in preparing financial reports after using this book." (3.93). This suggests that while the content and media of the textbook are good, the elements of active engagement and self-efficacy need to be guided through mentoring or stronger project-based intervention strategies during the instructional phases.

N-Gain Evaluation

Learning effectiveness is measured in N-Gain analysis by assessing results from pre-test, post-test, and in-class assessments. N-Gain is calculated based on the method proposed by Hake (1999), which states that to derive N-Gain, one must determine the difference between

the post-test and pre-test scores and divide it by the maximum score of the pre-test. Based on computation results, students' average pre-test score was 62.15, whereas the average post-test score rose to 84.50 out of 100. Based on these values, the N-Gain score is 0.59. Based on Hake's (1999 classification (1999) classification, a N-Gain score of 0.59 is moderately high. This indicates that multimedia textbooks embedded with QR Code videos dramatically improved student learning outcomes. Such increases in performance demonstrate that students not only achieve moderate levels of cognitive growth but also enhance their spreadsheet-based financial report preparation skills substantially. Sung et al. (2016) State that integrating multimedia in education enhances students' achievement by engaging two main cognitive channels, visual and verbal, reinforcing retention and grasping intricate concepts. Furthermore, in Multimedia Learning theory, Mayer (2020) Stated that the simultaneous inclusion of text, pictures, and videos in a single media interface facilitates better student processing and thus yields improved learning outcomes. Thus, N-Gain's results bolster the thesis concerning the innovation of textbook development based on multimedia and the effectiveness of learning in digital accounting.

Paired t-test Evaluation

An analysis with a paired sample t-test was used to check whether the difference between pre-test and post-test scores was significant. This test was done considering that measurements were done on the exact subject two times, before applying the learning intervention, and after applying the learning intervention, hence considering the internal relationship between data pairs. The analysis revealed that the t-value was 12.87 with df = 41 and p-value = 0.000. As the p-value is less than 0.05, the null hypothesis, which states no significant difference between the pre-test and the post-test, is disproved, while the alternative hypothesis is accepted. Thus, it can be said that there is a statistically significant difference in student learning outcomes before and posterior to the application of multimedia textbooks.

The substantial evidence supporting that the increase observed was not due to chance factors but a real effect of implementing video QR Code-based learning media is captured by the high t-value and very low p-value. These findings corroborate the results of Pan et al. (2020), who showed that incorporating video-based multimedia into education decreases cognitive load, enhances self-regulated learning, and improves academic achievement considerably. Moreover, according to Anderson and Krathwohl (2001)In the revision of Bloom's Taxonomy, innovative media substantially aid in nurturing students' higher-order thinking skills, underscoring the relevance of the analysis presented. All in all, the results from the paired t-test analysis reinforce the empirical testimony regarding multimedia-based textbooks, proving that they significantly improve the students' conceptual understanding and technical skills related to technology-automated accounting systems.

Discussion

This research confirms that creating a multimedia spreadsheet textbook integrated with QR Code videos significantly enhances students' conceptual understanding and technical skills in formulating financial statements. The data analysis shows an improvement in the average score from the pre-test to the post-test by 22.35, with an N-Gain value of 0.59, which falls under the medium-high category. (Hake, 1999). Furthermore, the paired t-test indicates a statistically significant difference between the values before and after using multimedia as learning aids, with a p-value of 0.000. This means that the innovative textbook not only serves as supplementary media but also supports the notion that it can serve as a paradigm shift

device in the meaningful improvement of student learning outcomes alongside the other media used.

From the learning innovation perspective, integrating QR Code video in textbooks represents a novel method combining print media and digital multimedia. As described in Multimedia Learning Theory, learning is most effective when information is received through visual and verbal channels simultaneously, which Mayer (2020) Also advocates for. By having video tutorials embedded in textbooks through QR codes, students achieve more than having text; they can see the application of spreadsheets in real-life situations. Sung et al. (2016) Accentuated that students' cognitive load is reduced, and information retention is enhanced through the visual representation of the process.

In addition, this development aligns with Kolb's (2014 Principles of learning as an experience where students learn actively and practically, reflecting on what was learned. This method is important in teaching subjects such as accounting because students are expected to learn the theory and its application in real life. The addition of videos through QR Codes enables assistance for practical work to be accessed at any time, which is the essence of learning, when required, a principle blended with self-instruction (AlNajdi, 2022). Both are essential in fostering flexible and adaptable 21st-century education. This research underscores the significance of multimedia-based learning materials and resources in addressing educational quality, as they have been proven to stimulate more active contextual learning relevant to industrial needs. The quality improvement is evident in three main aspects: (1) enhanced learning outcomes, (2) improved student motivation and participation, and (3) greater student preparedness to embrace digital working environments. This aligns with the findings of Tiron-Tudor et al. (2025) stressed that accounting education needs to incorporate aspects of digital skills and technology to prepare students to compete in this age of digital transformation. More significantly, the progress of developing this multimedia textbook aligns with achieving the Sustainable Development Goals (SDGs), particularly with SDG 4: Quality Education. SDG 4 focuses on ensuring access to education, which is inclusive and equitable, and promotes lifelong learning for all (UNESCO, 2022). By incorporating video QR Codes, textbooks can be used flexibly and tailored to different student situations. This can be done anytime and from anywhere, including those with limited face-to-face learning opportunities. Essentially, this innovation enhances educational inclusivity, which strengthens the accessibility of information technology, which is essential in the advancement of sustainable education.

The adoption of technology within textbook development has successfully contributed to creating a responsive learning system that adopts a more effective lifelong learning ecosystem in line with the new information and communication technologies. Reimers (2024) To put it best, stating that technology must be integrated into the education framework to foster flexible, critical, and innovative learners. Therefore, this research aims to address the innovation gap in the multimedia-based accounting education framework to be more effective and relevant in the Indonesian context. Furthermore, this research contributes to the global development agenda by focusing on building inclusive education systems that adapt to the needs of various learners and use sustainable resources, as highlighted in SDG 4.

5. Conclusion

As this study highlights, creating a multimedia-based spreadsheet textbook integrating QR Code videos has produced a learning medium that is valid, practical, and effective toward improving students' conceptual understanding and psychomotor skills in financial reporting. This textbook was developed using the Research and Development approach with the ADDIE model. The textbook is framed systematically, combining text with visualization and step-by-step video tutorials, promoting active, self-directed, and contextualized learning. Experts' Validation indicates that the information in the material is accurate, complete, and multimedia-integrated in an innovative technological approach. Students perceive the book as an accessible learning medium that facilitates understanding, motivation, and independent study.

Adopting this textbook enhances student learning engagement, motivation, and self-confidence in mastering digital accounting built on spreadsheets. Incorporating the QR Code video brings explanations of the procedures within reach and enhances understanding through visual and verbal means simultaneously. As such, this textbook with multimedia features strengthens psychomotor learning outcomes and cognitive learning, as well as cultivating students' preparedness to tackle the challenges posed by digital transformation in the workplace. This transformation also aids in advancing SDG number four, specifically, the target of providing education that is inclusive, adaptable, and of high quality about technological advancements.

In theory, this study builds accounting education multimedia literature by implementing the Multimedia Learning and Experiential Learning principles into the framework of the digital accounting textbooks. Practically, the textbooks address a gap in the innovative models offered for other courses within the accounting and professional education study programs through the integration of print and digital media. This study also illustrates the use of QR Codes to enhance self-paced and on-demand learning, which is becoming more important within today's education technology context.

The limitations of this study are numerous. There is still a single study program, and only a handful of respondents. Thus, extrapolating the findings from this study to other institutions or study programs would need to be done cautiously. Also, the short time in one learning cycle is insufficient to assess the long-term impact on students' mastery of skills or professional readiness. Also, this study did not control certain factors like students' baseline digital literacy or the availability of crucial technological devices. Future studies are encouraged to address these issues by developing and implementing multimedia textbooks in a broader context with more study programs and diverse higher education institutions to enhance the generalizability of the results. This study also requires longitudinal approaches that focus on the impact of the media on knowledge retention, skills, and career readiness. Moreover, the use of AR or VR and other advanced devices can be incorporated to enhance the interactivity and engagement level of the lessons. Different learning styles, self-reported feelings of tech confidence, and the necessity for motivation from within the student also play an important role in the effectiveness of technology-based learning media in accounting education.

6. References

Abdo-Salloum, A. M., & Al-Mousawi, H. Y. (2025). Accounting Students' Technology Readiness, Perceptions, and Digital Competence Toward Artificial Intelligence Adoption in Accounting Curricula. *Journal of Accounting Education, 70*, 100951. doi: https://doi.org/10.1016/j.jaccedu.2025.100951

Abdul Rabu, S. N., Hussin, H., & Bervell, B. (2019). QR code utilization in a large classroom: Higher education students' initial perceptions. *Educ Inf Technol (Dordr), 24*(1), 359-384. doi: 10.1007/s10639-018-9779-2

Ahmed, R. (2008). Spreadsheet Software as a Teaching and Learning Tool: Perspectives from an Undergraduate Financial Modelling Subject. *Review of Higher Education and Self Learning, 1*(1), 54-75. doi: http://dx.doi.org/10.2139/ssrn.1101208

Ahmed, W., & Zaneldin, E. (2020). Blending QR codes with video learning in the pedagogical process. *Interactive Technology and Smart Education, 17*(1), 67-85. doi: https://doi.org/10.1108/ITSE-08-2019-0043

Al-Hattami, H. M. (2025). Understanding how digital accounting education fosters innovation: The moderating roles of technological self-efficacy and digital literacy. *The International Journal of Management Education, 23*(2), 101131. doi: https://doi.org/10.1016/j.ijme.2025.101131

Alalwan, N., Cheng, L., Al-Samarraie, H., Yousef, R., Ibrahim Alzahrani, A., & Sarsam, S. M. (2020). Challenges and Prospects of Virtual Reality and Augmented Reality Utilization among Primary School Teachers: A Developing Country Perspective. *Studies in Educational Evaluation, 66*, 100876. doi: https://doi.org/10.1016/j.stueduc.2020.100876

AlNajdi, S. M. (2022). The effectiveness of using augmented reality (AR) to enhance student performance: using quick response (QR) codes in student textbooks in the Saudi education system. *Educ Technol Res Dev, 70*(3), 1105-1124. doi: 10.1007/s11423-022-10100-4

AlShaikh, R., Al-Malki, N., & Almasre, M. (2024). The implementation of the cognitive theory of multimedia learning in the design and evaluation of an AI educational video assistant utilizing large language models. *Heliyon, 10*(3), e25361. doi: https://doi.org/10.1016/j.heliyon.2024.e25361

Andiola, L. M., Masters, E., & Norman, C. (2020). Integrating technology and data analytics skills into the accounting curriculum: Accounting department leaders' experiences and insights. *Journal of Accounting Education, 50*, 100655. doi: https://doi.org/10.1016/j.jaccedu.2020.100655

Bavaresco, R. S., Nesi, L. C., Victória Barbosa, J. L., Antunes, R. S., da Rosa Righi, R., da Costa, C. A., . . . Moreira, C. (2023). Machine learning-based automation of accounting services: An exploratory case study. *International Journal of Accounting Information Systems, 49*, 100618. doi: https://doi.org/10.1016/j.accinf.2023.100618

BNSP. (2021). *Standar Proses Pendidikan Dasar dan Menengah*. Jakarta: Badan Standar Nasional Pendidikan.

Borthick, A. F., & Schneider, G. P. (2023). Getting Students Ready for Accounting Spreadsheets: Training for Basic Spreadsheet Skills with Pre/Post Assessments. *Issues in Accounting Education, 38*(2), 63-84. doi: 10.2308/issues-2021-010

Bradbard, D. A., Alvis, C., & Morris, R. (2014). Spreadsheet usage by management accountants: An exploratory study. *Journal of Accounting Education, 32*(4), 24-30. doi: https://doi.org/10.1016/j.jaccedu.2014.09.001

Branch, R. M. (2009). *Instructional Design: The ADDIE Approach*. New York: Springer.

Coovadia, H., & Ackermann, C. (2021). Integrating digital pedagogies into a typical student learning lifecycle and its effect on exam performance. *Accounting Education, 30*(1), 42-62. doi: 10.1080/09639284.2020.1811993

Deng, X. N., & Yi, S. (2025). Individual motivation and self-perception of excel skills learning: An empirical study of first-generation college students and their peers. *Journal of Accounting Education, 70*, 100947. doi: https://doi.org/10.1016/j.jaccedu.2024.100947

Gall, M. D., Gall, J. P., & Borg, W. R. (2003). *Educational Research: An Introduction*: Allyn and Bacon.

Greer, D. L., Crutchfield, S. A., & Woods, K. L. (2013). Cognitive Theory of Multimedia Learning, Instructional Design Principles, and Students with Learning Disabilities in Computer-based and Online Learning Environments. *Journal of Education, 193*(2), 41-50. doi: 10.1177/002205741319300205

Hake, R. R. (1999). *Analyzing Change/Gain Scores*: Indiana University.

Heidig, S., Müller, J., & Reichelt, M. (2015). Emotional design in multimedia learning: Differentiation on relevant design features and their effects on emotions and learning. *Computers in Human Behavior, 44*, 81-95. doi: https://doi.org/10.1016/j.chb.2014.11.009

Karia, C. T., Hughes, A., & Carr, S. (2019). Uses of quick response codes in healthcare education: a scoping review. *BMC Med Educ, 19*(1), 456. doi: 10.1186/s12909-019-1876-4

Leite, S. (2022). Using the SDGs for global citizenship education: definitions, challenges, and opportunities. *Globalisation, Societies and Education, 20*(3), 401-413. doi: 10.1080/14767724.2021.1882957

Li, M., Zhou, D., Liu, X., & Zan, H. (2025). Simulation of E-learning virtual interaction in Chinese language and literature multimedia teaching system based on video object tracking algorithm. *Entertainment Computing, 52*, 100764. doi: https://doi.org/10.1016/j.entcom.2024.100764

Mayer, R. E. (2020). *Multimedia Learning* (3 ed.). Cambridge: Cambridge University Press.

Mayer, R. E., & Moreno, R. (2020). A cognitive theory of multimedia learning: Implications for design principles. *Educational Psychology Review, 32*(2), 187-204. doi: https://doi.org/10.1007/s10648-020-09556-4

McKenney, S., & Reeves, T. (2018). *Conducting Educational Design Research (2nd ed.)*. London: Routledge.

Minard, C. (2024). Use of QR Codes to Enhance Learning in a Graduate-Level Clinical Course. *Journal of Formative Design in Learning, 8*(2), 63-70. doi: 10.1007/s41686-024-00092-0

Molenda, M. (2015). In Search of the Elusive ADDIE Model. *Performance Improvement, 42*(5), 34-36. doi: 10.1002/pfi.4930420508

Pan, C.-C., Murray, D., & King-May Yang, S. (2020). Effectiveness of multimedia-based learning on cognitive load, self-regulation, and learning achievement. *Educational Technology Research and Development, 68*, 2741-2762. doi: https://doi.org/10.1007/s11423-020-09773-4

Peters, M. D., & Chiu, C. (2022). Interactive Spreadsheeting: A Learning Strategy and Exercises for Calculative Management Accounting Principles. *Issues in Accounting Education, 37*(4), 47-60. doi: 10.2308/issues-2020-093

Plass, J. L., Heidig, S., Hayward, E. O., Homer, B. D., & Um, E. (2014). Emotional design in multimedia learning: Effects of shape and color on affect and learning. *Learning and Instruction, 29*, 128-140. doi: https://doi.org/10.1016/j.learninstruc.2013.02.006

Reeves, T. (2006). *Design research from a technology perspective*. New York: Routledge.
Reigeluth, C. M. (2016). *Instructional theory: The essential readings*: Routledge.
Reimers, F. M. (2024). The sustainable development goals and education, achievements, and opportunities. *International Journal of Educational Development, 104*, 102965. doi: https://doi.org/10.1016/j.ijedudev.2023.102965
Rodrigues, R., & Silva, M. (2022, 2022//). *Emotional Design in Multimedia Learning: Systematic Review*. Paper presented at the Advances in Design and Digital Communication II, Cham.
Rose, D., Meyer, A., & Gordon, D. (2013). *Universal Design for Learning: Theory and Practice*: CAST Professional Publishing.
Sung, Y.-T., Chang, K.-E., & Liu, T.-C. (2016). The effects of integrating mobile devices with teaching and learning on students' learning performance: A meta-analysis and research synthesis. *Computers & Education, 94*, 252-275. doi: https://doi.org/10.1016/j.compedu.2015.11.008
Tettamanzi, P., Minutiello, V., & Murgolo, M. (2023). Accounting education and digitalization: A new perspective after the pandemic. *The International Journal of Management Education, 21*(3), 100847. doi: https://doi.org/10.1016/j.ijme.2023.100847
Tiron-Tudor, A., Labaditis, A., & Deliu, D. (2025). Future-Ready Digital Skills in the AI Era: Bridging Market Demands and Student Expectations in the Accounting Profession. *Technological Forecasting and Social Change, 215*, 124105. doi: https://doi.org/10.1016/j.techfore.2025.124105
Tsoukala, E., Lefkos, I., & Fachantidis, N. (2024, 2024//). *Exploring the Applications of QR Codes in STEM Subjects*. Paper presented at the Smart Mobile Communication & Artificial Intelligence, Cham.
UNESCO. (2022). Reimagining Our Futures Together: A New Social Contract for Education. Retrieved April 14, 2025, from https://unesdoc.unesco.org/ark:/48223/pf0000381317
van Borkulo, S. P., Chytas, C., Drijvers, P., Barendsen, E., & Tolboom, J. (2023). Spreadsheets in Secondary School Statistics Education: Using Authentic Data for Computational Thinking. *Digital Experiences in Mathematics Education, 9*(3), 420-443. doi: 10.1007/s40751-023-00126-5
Van den Akker, J., Plomp, T., Bannan, B., Nieveen, N., Kelly, A. E., Plomp, T., . . . Nieveen, e. (2013). *Educational Design Research: An Introduction*: Netherlands Institute for Curriculum Development.
Wang, W., Huang, Z., Fu, Z., Jia, L., Li, Q., & Song, J. (2024). Impact of digital technology adoption on technological innovation in grain production. *Journal of Innovation & Knowledge, 9*(3), 100520. doi: https://doi.org/10.1016/j.jik.2024.100520
Willis, V. (2016). A model for teaching technology: Using Excel in an accounting information systems course. *Journal of Accounting Education, 36*. doi: 10.1016/j.jaccedu.2016.05.002
Zahidi, G. E. E. H. O. L. T. M. S. (2024). Shaping the Future of Learning: The Role of AI in Education 4.0. Retrieved April 13, 2025, from https://www.weforum.org/publications/shaping-the-future-of-learning-the-role-of-ai-in-education-4-0/