J Euro Eco His.
ISSN : 0391-5115
Volume 2, Issue 1 (2021)
THE JOURNAL OF EUROPEAN ECONOMIC HISTORY

Virtual Labs for Teaching Accounting Practices: Design, Implementation, and Learning Outcomes in Digital-First Accounting Education

Ayaan Rahman, PhD
Department of Accounting & Information Systems, Eastbridge University of Business, Kolkata, India

Meera Nair, MBA, CPA (Dummy)
School of Management, Coastal Institute of Commerce, Kochi, India

Tariq Hassan, MSc (EdTech)
Center for Digital Learning Innovation, North Valley University, Guwahati, India

Abstract

Virtual labs are emerging as a practical approach for teaching accounting practices in environments where enterprise systems, audit tools, and realistic transaction cycles are otherwise difficult to provide at scale. This paper develops a structured framework for virtual accounting labs—interactive, scenario-based learning environments that simulate business processes such as procure-to-pay, order-to-cash, payroll, bank reconciliation, and period-end closing. Drawing on learning theory and information systems success models, the study proposes a design architecture that integrates authentic datasets, role-based tasks, feedback loops, assessment rubrics, and analytics dashboards. A mixed-method evaluation design is presented, including pre/post competency assessments, task-performance logs, and student perception measures. Results from a pilot-style evaluation (illustrative dataset) show improvements in procedural accuracy, internal-control reasoning, and technology confidence, with the strongest gains among students with limited prior exposure to accounting software. The paper concludes with implementation guidance for faculty, governance considerations (privacy, academic integrity, accessibility), and a future research agenda around AI-assisted feedback and adaptive lab pathways.

Key Words: virtual lab, accounting education, simulation-based learning, ERP simulation, audit analytics, experiential learning, competency-based assessment, digital transformation

Introduction

Accounting practice has shifted rapidly from manual bookkeeping to technology-mediated workflows involving cloud accounting, ERP modules, automated reconciliations, continuous auditing, and data-driven assurance. While curricula often introduce these themes conceptually, many students still graduate without repeated hands-on exposure to complete transaction cycles, control documentation, and system-based reporting. The gap is not merely about using a tool; it is about practicing accounting thinking inside realistic processes—entering transactions with proper documentation, recognizing errors, tracing audit trails, handling exceptions, and interpreting dashboards.

Virtual labs address this gap by offering a controlled learning environment that mimics real organizational accounting systems and workflows. Unlike generic software demos, a virtual lab

J Euro Eco His.
ISSN : 0391-5115
Volume 2, Isue 1 (2021)
THE JOURNAL OF EUROPEAN ECONOMIC HISTORY

is structured around learning outcomes, practice repetition, and evidence-based assessment. Students can perform tasks such as vendor setup, invoice processing, approval workflows, bank matching, adjusting entries, and financial statement generation—while receiving formative feedback and building competency.

This paper contributes by (a) defining the concept and essential components of virtual labs for accounting practice, (b) proposing a design-and-governance framework aligned to competency-based learning, (c) outlining an evaluation methodology suitable for accounting programs, and (d) presenting an illustrative pilot evaluation with actionable implementation guidance.

2. Conceptual Background and Related Literature

2.1 Experiential learning and "learning-by-doing" in accounting

Experiential learning theory argues that knowledge is constructed through concrete experience, reflective observation, conceptualization, and active experimentation. Accounting practice—journalizing, reconciliations, control checks—fits naturally into this cycle because proficiency depends on repeated procedural execution and judgment under constraints. Simulation-based learning extends experiential learning by enabling controlled, repeatable practice without organizational risk (Kolb, 1984).

Virtual labs operationalize experiential learning by structuring practice episodes: students act as junior accountants or auditors, interact with transaction documents, complete system tasks, review errors, and iterate. This aligns with competency-based accounting education and outcome-based assessment approaches increasingly reflected in professional education standards (IFAC, 2019).

2.2 Technology acceptance and learning adoption

Successful use of virtual labs also depends on perceived usefulness and ease of use, as described in the Technology Acceptance Model (Davis, 1989). If a lab is too complex, students may focus on navigation rather than learning. If it feels irrelevant to assessment and career outcomes, engagement declines. Therefore, lab design must balance authenticity and usability: real-world complexity is introduced gradually through scaffolded pathways.

2.3 Measuring effectiveness: Information systems success in education

Virtual labs are information systems embedded in pedagogy. Their success can be evaluated using models such as DeLone and McLean's IS success framework, which links system quality and information quality to use, satisfaction, and net benefits (DeLone & McLean, 2003). In education, "net benefits" can be interpreted as skill gains, reduced error rates, improved internal-control reasoning, and higher confidence in accounting technologies.

2.4 Professional competency expectations

International Education Standards (IES) emphasize technical competence, professional skills, and values/ethics. Virtual labs can directly map to these competencies through tasks like documenting audit evidence, applying segregation-of-duties logic, and performing analytical procedures (IFAC, 2019). The AICPA competency perspective also highlights technology and critical-thinking integration (AICPA, 2018).

3. Defining Virtual Accounting Labs

A **virtual accounting lab** is a digital learning environment that simulates accounting systems, documents, and workflows to enable students to practice end-to-end accounting tasks under structured guidance and assessment.

3.1 Essential features

A robust virtual lab typically includes:

1. **Scenario engine:** Business context (industry, company profile, policies).
2. **Transaction datasets:** Sales orders, invoices, GRNs, payroll registers, bank statements.
3. **System interface:** ERP-like screens or cloud-accounting equivalents (or sandboxed real tools).
4. **Role-based access:** Student acts as AP clerk, AR clerk, accountant, approver, auditor.
5. **Feedback & hints:** Immediate checks, error explanations, and remediation steps.
6. **Assessment:** Rubrics for accuracy, reasoning, documentation quality, and controls.
7. **Learning analytics:** Task time, attempt counts, error patterns, and progress dashboards.
8. **Integrity controls:** Randomized data variants, audit logs, plagiarism-resistant outputs.
9. **Accessibility:** Keyboard navigation, screen-reader support, low-bandwidth alternatives.

3.2 Lab scope: From micro-skills to full cycles

Virtual labs can be designed as:

- **Micro-labs:** Single skills (e.g., bank reconciliation matching, adjusting entries).
- **Process labs:** Sub-cycles (procure-to-pay, order-to-cash).
- **Capstone labs:** Integrated month-end close, including accruals, reconciliations, reporting.

4. Research Objectives and Questions

4.1 Objectives

This study aims to:

1. Propose a design framework for virtual labs that teaches accounting practices authentically.
2. Present an assessment model aligned with accounting competencies and controls reasoning.
3. Evaluate the impact of virtual lab participation on learning outcomes and perceptions.

4.2 Research questions

RQ1: Do virtual labs improve students' procedural competency in accounting tasks (accuracy and completeness)?
RQ2: Do virtual labs improve internal-control reasoning and audit-trail understanding?
RQ3: How do system quality and perceived usefulness influence engagement and outcomes?
RQ4: What implementation factors (scaffolding, feedback design, dataset realism) predict success?

5. Proposed Framework: The V-LAB Accounting Practice Model

The **V-LAB model** organizes implementation into five layers: **(V)** Vision & outcomes, **(L)** Learning design, **(A)** Architecture & assets, **(B)** Behavior analytics, and **(S)** Standards & governance.

Figure 1. V-LAB Accounting Practice Model (conceptual diagram)

```
+------------------------------------------------------------+
| (V) Vision & Outcomes                                      |
```

```
|  - Competency map (IES/AICPA aligned)                    |
+------------------------+------------------------------------+
| (L) Learning Design     | (A) Architecture & Assets          |
|  - Scaffolding          |  - Sandbox system / simulated UI    |
|  - Feedback loops       |  - Datasets + documents            |
|  - Rubrics              |  - Role-based workflows            |
+------------------------+------------------------------------+
| (B) Behavior Analytics                                    |
|  - Error patterns, time-on-task, attempts, mastery tracking    |
+--------------------------------------------------------------+
| (S) Standards & Governance                                |
|  - Privacy, accessibility, integrity, audit logs, versioning   |
+--------------------------------------------------------------+
```

5.1 Vision & outcomes (competency mapping)

Each lab task should map to measurable outcomes. Example mapping:

- **Technical:** Record transactions, reconcile accounts, prepare statements.
- **Professional skills:** Problem-solving, documentation, communication of exceptions.
- **Ethics & controls:** Segregation-of-duties reasoning, evidence retention, approvals.

5.2 Learning design (scaffolding and feedback)

A frequent failure in simulations is “throwing students into complexity.” The V-LAB model recommends:

- **Guided mode → Practice mode → Challenge mode**
- Hints that **explain why** an entry is wrong (conceptual feedback), not just “incorrect.”
- Reflection prompts: “Which control failed?” “What evidence supports your adjustment?”

5.3 Architecture & assets

Institutions can implement labs using:

- **Simulated ERP interface** (custom UI with scripted rules)
- **Sandboxed real tools** (training accounts in cloud accounting/ERP education editions)
- **Hybrid** (real tool + simulated audit analytics and documentation layer)

5.4 Behavior analytics

Analytics should support learning, not surveillance. Key indicators:

- Error categories (classification, timing, documentation, control override)
- Attempts to mastery
- Time on task and bottlenecks
- Integrity flags (unusual speed, identical narratives)

5.5 Standards & governance

Governance includes:

- Dataset versioning and answer-key security
- Student privacy (data minimization)
- Accessibility compliance
- Clear integrity policy and proctoring alternatives

6. Virtual Lab Design: Example Modules

6.1 Procure-to-Pay (P2P) Lab

Scenario: Mid-sized distributor purchasing inventory.

Student tasks:

1. Create vendor master with tax fields
2. Enter purchase order
3. Record goods receipt (GRN)
4. Post vendor invoice (3-way match rules)
5. Process payment and generate AP aging

Skills learned: recognition, matching controls, approval logic, audit trail.

6.2 Bank Reconciliation Lab

Scenario: Bank statement includes charges, deposits in transit, NSF items.

Student tasks:

- Auto-match transactions
- Investigate exceptions
- Post adjusting entries
- Produce reconciliation report with explanations

Skills learned: reconciliation reasoning, completeness, evidence documentation.

6.3 Month-End Close Mini-Capstone

Scenario: Accruals, prepayments, depreciation, inventory adjustments.

Student tasks:

- Create adjusting entries
- Run trial balance and investigate anomalies
- Produce financial statements with notes

Skills learned: period-end logic, analytical review, reporting.

7. Methodology

7.1 Research design

A **mixed-method** approach is recommended for evaluating virtual labs:

- **Quantitative:** pre/post tests; performance scoring; log analytics
- **Qualitative:** reflections; focus groups; instructor observations

7.2 Participants (illustrative pilot configuration)

Undergraduate accounting students enrolled in an "Accounting Information Systems" or "Practical Accounting" course can be divided into:

- **Lab group:** receives virtual lab modules + guided instruction
- **Comparison group:** receives traditional instruction + paper-based cases (or limited demos)

7.3 Instruments

1. **Procedural competency test:** task-based items (journal entries, reconciliation steps).
2. **Controls reasoning test:** scenarios asking which control mitigates which risk.
3. **Perception survey:** TAM-style measures (usefulness, ease of use) (Davis, 1989).

4. **System success survey:** system quality, information quality, satisfaction (DeLone & McLean, 2003).
5. **Rubric scoring:** accuracy, completeness, documentation, audit-trail clarity.

7.4 Data collection

- Pre-test (Week 1)
- Labs (Weeks 2–10)
- Post-test + survey (Week 11)
- Focus groups (Week 12)

7.5 Analysis plan

- **Learning gains:** paired t-tests or ANCOVA controlling for baseline knowledge.
- **Engagement effects:** regression using log metrics (time, attempts) as predictors.
- **Mediation:** perceived usefulness → engagement → outcomes (conceptual).

8. Results (Illustrative Pilot Findings)

Note: The following results are presented in a "pilot-style" format to demonstrate reporting structure and key metrics commonly used in education evaluation. They are illustrative and should be replaced with actual institutional data during real implementation.

8.1 Procedural competency gains

Students using the lab showed higher improvements in transaction accuracy and reconciliation correctness.

- **Accuracy score (0–100):** Lab group improved from 54 to 78; comparison from 55 to 66.
- Greatest improvements were in **3-way match reasoning** and **exception handling**.

8.2 Internal-control reasoning gains

The lab group improved more in identifying control failures and appropriate remediation steps—particularly in scenarios involving approval overrides and documentation gaps.

8.3 Perceptions and engagement

Students reported the lab was most valuable when feedback was immediate and when tasks connected clearly to assessments. Ease-of-use issues appeared early but decreased after guided onboarding.

9. Discussion

9.1 Why virtual labs improved learning

Virtual labs likely improved outcomes through repeated deliberate practice: students performed tasks multiple times, received prompt feedback, and corrected errors. This aligns with experiential learning cycles (Kolb, 1984). In contrast, paper cases often measure "knowing what to do" rather than "being able to do it" under system constraints.

9.2 The role of authenticity (documents + workflow)

Students reported stronger understanding when the lab included realistic source documents (POs, invoices, bank statements) and required them to attach evidence or justify exceptions.

This supports the argument that accounting competence includes auditability and documentation discipline, not only correct numbers.

9.3 Technology acceptance matters

Perceived usefulness influenced sustained engagement: students engaged more when they believed the lab resembled workplace tools and improved employability. Ease of use influenced early drop-off, reinforcing the need for onboarding and scaffolding (Davis, 1989).

9.4 Implications for accounting curricula

Virtual labs can serve as a bridge between theory and practice by embedding conceptual topics—like internal controls, accruals, and revenue recognition—inside process tasks and evidence requirements. They also enable competency-based assessment aligned to professional education standards (IFAC, 2019).

10. Implementation Guide for Faculty and Institutions

10.1 Start small: a "minimum viable lab"

A practical pathway:

1. Begin with **bank reconciliation** (high value, low system complexity).
2. Add **AP 3-way match** (controls + workflow).
3. Integrate into a **month-end close** mini-capstone.

10.2 Assessment strategy

Use dual assessment:

- **Formative:** hints, retries, guided feedback, reflection prompts
- **Summative:** randomized dataset variant + rubric + short viva/defense

10.3 Academic integrity and fairness

- Randomize transaction amounts, dates, and vendor names per student.
- Require brief written rationales for exceptions (harder to copy).
- Use audit logs to flag unlikely completion patterns.

10.4 Accessibility and inclusion

Provide:

- Low-bandwidth "document-first" mode (downloadable packets + later upload)
- Keyboard-friendly interface
- Alternative assessment routes for students with limited device access

11. Limitations and Future Research

11.1 Limitations

- Outcomes may vary by instructor skill, lab usability, and student digital readiness.
- Short-term pilots may not capture long-term retention or workplace transfer.
- If the lab tool is too vendor-specific, learning may become tool-bound.

11.2 Future research directions

- **Adaptive labs:** difficulty adjusts based on error patterns.

- **AI feedback:** natural-language coaching for reconciliation explanations and audit memos.
- **Team-based labs:** simulating segregation of duties with collaborative workflow roles.
- **Authentic assessment validity:** linking lab performance to internship supervisor ratings.

12. Conclusion

Virtual labs offer a scalable, pedagogy-driven method to teach accounting practices in a way that aligns with modern digital workflows. By combining realistic transaction cycles, evidence-based documentation, feedback loops, and competency-aligned assessment, virtual labs can strengthen procedural skills and internal-control reasoning while improving students' confidence with accounting technologies. Institutions adopting virtual labs should prioritize scaffolding, usability, governance, and integrity-by-design. Done well, virtual labs can meaningfully reduce the gap between classroom learning and professional accounting practice.

Figure 2. Example "Virtual Lab Screen" (illustrative image placeholder)
Image description (for inclusion in the paper as a figure):

A dashboard-style screen showing: (a) the scenario ("AP Clerk—Invoice Processing"), (b) task checklist (Vendor verified → PO matched → GRN verified → Invoice posted), (c) document panel with invoice PDF preview, and (d) feedback box highlighting a mismatch ("Invoice quantity exceeds GRN; investigate partial delivery or correct entry").

(In a Word/PDF manuscript, this can be represented as a clean UI mockup screenshot or a diagram created in PowerPoint/Canva.)

References

1. AICPA. (2018). *CPA Evolution model curriculum: Overview and resources* (dummy-citable framework reference). American Institute of Certified Public Accountants.
2. Bloom, B. S. (1956). *Taxonomy of educational objectives: The classification of educational goals*. Longmans.
3. Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly, 13*(3), 319–340.
4. DeLone, W. H., & McLean, E. R. (2003). The DeLone and McLean model of information systems success: A ten-year update. *Journal of Management Information Systems, 19*(4), 9–30.
5. IFAC. (2019). *International Education Standards (IES) for professional accountants*. International Federation of Accountants.
6. Kolb, D. A. (1984). *Experiential learning: Experience as the source of learning and development*. Prentice Hall.
7. Lave, J., & Wenger, E. (1991). *Situated learning: Legitimate peripheral participation*. Cambridge University Press.
8. Mayer, R. E. (2009). *Multimedia learning* (2nd ed.). Cambridge University Press.
9. Prince, M. (2004). Does active learning work? A review of the research. *Journal of Engineering Education, 93*(3), 223–231.
10. Roediger, H. L., & Karpicke, J. D. (2006). Test-enhanced learning: Taking memory tests improves long-term retention. *Psychological Science, 17*(3), 249–255.
11. Sweller, J. (1988). Cognitive load during problem solving: Effects on learning. *Cognitive Science, 12*(2), 257–285.

12. Wenger, E. (1998). *Communities of practice: Learning, meaning, and identity*. Cambridge University Press.