

SmartShop: Generative Artificial Intelligence Enhanced Inventory Assistant for Agricultural Learning Laboratories

Need for Innovation or Idea

School-based agriculture education (SBAE) teachers are required to maintain detailed records of content-specific equipment manifests, including greenhouse, mechanics lab, and computer lab equipment (Twenter & Edwards, 2017). The need for required records is often treated as a low-priority task compared to the volume of responsibilities in an SBAE teacher's daily tasks (Haddad et al., 2023). However, when materials, reports, or equipment value are needed, the need becomes immediate, adding to fatigue and anxiety (Clemons et al., 2021; Sevnarayan et al., 2024; Williams et al., 2026; Haddad et al., 2024). Current records of consumable and capital purchases are often required for extended contract applications, Perkins funding, and school system inventory per administrative mandate. Without an easily accessible, intuitive record program, the program is subject to reduced funding, the absence of needed equipment, and fewer learning opportunities for students in SBAE programs (McKibben et al., 2022). SBAE needs up-to-date information at the right moment, without additional constraints or time and effort, to accurately identify and predict equipment and material needs. To improve cognitive offloading, optimize time constraints, and streamline the production of inventory manifests for SBAE teachers, we have developed the SmartShop application. This app-based program consolidates capital equipment, consumables, depreciation, and inventory, and automates end-of-year fiscal reporting. Instead of a desktop-based Excel or other time-intensive record system, the SmartShop app was designed for ease of access, velocity-centric input, instant access to on-hand materials when away from the laboratory, and analysis of materials and consumable use in given timeframes.

How it Works

The SmartShop application streamlines inventory management using a recursive learning model to learn which items are most often needed by teachers and students. By adding consumable materials to the inventory, the application quantifies each item by curriculum type, time of year used, and estimated amount used. The user scans the product's UPC from their mobile device. The item is sorted, assigned, and saved in the appropriate app location. Capital equipment purchases are added to the app manually and assigned the purchase cost, the equipment's real or estimated age, and its general condition. The app then applies straight-line depreciation calculated from the user variables to determine longevity and when replacement is justified. The application separates each item into *inventory*, *low stock*, and *replace now* with visual progress bars showing the percentage remaining. The inventory application uses a recursive learning model to calculate the consumption rate. Users choose from a list of curricula (e.g., welding, construction, plumbing, etc.) to help the AI learn specific consumption patterns. By analyzing the frequency of low stock indicators relative to the academic calendar, we can develop a predictive consumption model. Using AI predictive analytics, the app provides recommendations for items based on the academic calendar and usage patterns. As new data is ingested, the app learns the nearest store, favorite locations, updates inventory to address out-of-stock issues, and generates editable .pdf purchase orders and inventory reports using the jsPDF extension for local, state, and federal agencies. To maintain data security, information is synchronized with an encrypted Google Cloud Storage vault (via Firebase) that requires Two-Factor Authentication for user access and report generation. The application was built with TypeScript and JavaScript

XML as a modular architecture for high-velocity data ingestion and automated reporting. By partitioning the build into four primary domains, the risk of conflation is eliminated while maintaining the function and organization of the backend processes (Wei et al., 2022). The user interface uses the ZXing decoding suite to process UPC, EAN, QR, etc., barcode scans and convert physical item descriptions to digital records. Capital equipment is manually entered using the Gemini 3.0 API and aligned to a global database template using ISO protocols to ensure naming consistency and high fidelity (Clemons & Haddad, 2026) across multiple laboratory environments. Capital equipment is managed using a deterministic mathematical model to calculate straight-line depreciation and to support long-term budget forecasting, assisting with funding agencies and administrative reporting mandates.

Results to Date and Implications

The Smartshop app is functionally complete and undergoing alpha and limited beta testing. Early results show that consolidating reporting information on a mobile platform has streamlined and improved users' efficiency in administrative and organizational tasks. The result is a self-updating, self-regulating inventory system that notifies teachers when stock is running low and generates both vendor-specific orders and order forms. By shifting from manual addition and subtraction to a recursive, predictive learning model, educators can maximize their time and better align their instruction with students, thereby increasing the efficiency of inventory management, financial reporting, and equipment mitigation.

Future Plans and Advice to Others

The transition from manual entry, spreadsheet, or similar software tracking to a recursive AI model requires a well-designed preparatory phase. Educators should establish a data cleansing routine before uploading existing data to the app. This involves reconciling manifests to ensure baseline data entry is accurate. The efficacy of the recursive AI learning model depends on the quality of the initial data being ingested by the app and backend software. The goal of this app is to minimize administrative activities that promote burnout and fatigue and to maximize time and effort toward student, classroom, and program development. As the app undergoes testing [STATE], updates will include 1) phase mapping where inventory is mapped to curriculum needs, e.g. daily welding consumables vs. annual greenhouse soil orders; 2) update the UPC camera access to include autofocus to minimize latency during analysis; 3) analyze users initial time investment (30 days) to identify data trends for code improvement and efficiency of software and API calls; 4) improve depreciation schedules to include both straight-line and declining balance models; 5) potential modularization for other CTE sector adoption 6) data collection, analysis of SBAE change in AI use perception when using the app (Lindner et al., 2026).

Costs and Resources

The Smartshop application is designed for low-barrier entry and to leverage the existing program and SBAE teacher infrastructure where possible. Time was the most significant expenditure in development (50 hrs.). User costs, based on SBAE teachers' existing mobile technology (\$0.00), school Wi-Fi/cellular (\$0.00), SBAE app setup time (10 hours), GCS vaulting (\$0.00), subscription for [STATE] SBAE teachers (zero cost for full user install base offset by [UNIVERSITY] AELC program development/outreach allocation.

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