

**DEVELOPMENT OF SOFTWARE FOR INTEGRATED MANAGEMENT OF SCHOOLCHILDREN'S
LEARNING PROCESS IN A LANGUAGE SCHOOL**

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Анотація

У роботі розглянуто розробку програмного забезпечення для інтегрованого менеджменту процесу навчання школярів у мовній школі за принципом «в одному вікні» для менеджера. Система охоплює повний цикл взаємодії з учнем: від першого звернення та комунікації, запису на пробні й регулярні заняття, ведення розкладу та обліку абонементів до контролю оплат, відвідуваності й формування звітності. Визначено ключові точки автоматизації, запропоновано модульну архітектуру з ролями користувачів (менеджер/викладач/адміністратор), інтеграцію CRM, календаря/розкладу, абонементів і платежів, а також інтеграційну шину на основі API для підключення платформи та месенджерів. Описано підхід до комплексного тестування та методик оцінювання KPI до/після впровадження (час обробки звернень, точність обліку, частка продовжень).

Ключові слова: мовна школа; управління навчанням; CRM; розклад занять; абонементи; платежі; відвідуваність; нагадування; інтеграція; KPI.

Abstract

This paper presents the development of software for the integrated management of schoolchildren's learning process in a language school, conceived as a 'single-window' system for a school manager. The solution covers the full learner lifecycle: initial enquiry handling and communications, booking trial and regular lessons, timetable management, subscription tracking, payment control, attendance monitoring, and managerial reporting. The study identifies key automation points in the school's business processes and proposes a modular architecture with role separation (manager/teacher/administrator), integration of CRM, scheduling, subscriptions, and payments, and an API-based integration layer to connect external learning platforms and messengers. A comprehensive testing approach and a KPI evaluation plan are outlined to measure impact before and after deployment, including enquiry processing time, accounting accuracy, and renewal rate.

Keywords: language school; learning management; CRM; timetabling; subscriptions; payments; attendance; automated reminders; system integration; KPI.

Language schools serving school-age learners often rely on a patchwork of spreadsheets, messaging apps, and manual bookkeeping to handle enquiries, schedule lessons, track subscriptions, and reconcile payments. Fragmentation creates avoidable delays, inconsistent records, and revenue leakage (missed payments and untracked renewals), while teachers and managers spend time on administrative tasks rather than on instructional quality. Integrated educational management systems can reduce operational friction by consolidating CRM, scheduling, and billing into a single data model and by automating routine reminders [1, 2].

The objective of this work is to design and implement a prototype (MVP) of an integrated 'single-window' system for a language school manager that supports the end-to-end chain 'enquiry → enrolment → timetable → subscription → payment → attendance → reporting'. The object of study is the comprehensive process of managing pupils' learning in a language school; the subject is the architectural solutions and software modules integrating CRM, scheduling, subscriptions, and payments. The expected outcome is a role-based system with auditable operations and measurable improvements in key performance indicators (KPIs). [2, 4].

BUSINESS PROCESS AND REQUIREMENTS

Requirements are derived by modelling the school's business processes from the initial contact through ongoing service delivery. The process begins with capturing an enquiry (channel, contact details, learner profile, preferred level, and time slots), continues with qualification and a trial lesson booking, and then

transitions to enrolment, regular scheduling, subscription issuance, payment tracking, and attendance monitoring. Explicit state transitions (lead → trial booked → active learner → renewal due → lapsed) enable consistent reporting and automation triggers [1, 3].

Key automation points include: (i) inbound lead registration with consent and communication preferences, (ii) automated selection of trial slots based on teacher availability, (iii) subscription lifecycle management (sessions remaining, expiry rules, freeze options), (iv) payment reminders and overdue handling, and (v) attendance capture with exception workflows (rescheduling, make-up lessons). Non-functional requirements include single-source-of-truth data, predictable role separation, privacy-by-design for minors' data, and resilience to integration failures [4-6, 8].

ARCHITECTURE AND INTEGRATION

The proposed architecture is modular and service-oriented: CRM/learner registry, scheduling, subscriptions, payments, communications, and reporting are separated into cohesive modules connected through a unified API and a shared identifier scheme for learners, contracts, and lessons. The integration layer provides adapters to external platforms (e.g., videoconferencing or learning portals) and messengers used for notifications. An event-driven approach is recommended for time-sensitive actions such as reminders and renewal prompts, while a transactional core ensures consistency for enrolment, subscription issuance, and payment posting [2, 7].

Role-based access control is used to enforce operational boundaries: managers can create and modify schedules and financial records; teachers can view assigned learners, lessons, and attendance, and can propose reschedules; administrators manage users, reference data, and integration credentials. Audit logging captures critical actions (price changes, manual payment adjustments, subscription freezes, and attendance edits) to support dispute resolution and internal control [4, 6].

IMPLEMENTATION AND TESTING

The MVP implements: (1) learner and contact management with interaction history; (2) booking for trial and regular lessons with conflict detection and capacity rules; (3) subscription management with session counters and expiry policies; (4) payment module supporting status tracking (paid/partially paid/overdue), reminders, and reconciliation; and (5) reporting dashboards for operational and financial metrics. The API gateway exposes controlled endpoints for partner integrations and message templates for automated notifications [2, 5].

Testing is conducted at multiple levels: unit tests for business rules (e.g., subscription decrement, reschedule constraints), integration tests for calendar/payment adapters, and end-to-end scenarios that cover the full learner lifecycle. Particular attention is paid to race conditions (simultaneous bookings), idempotency for payment callbacks, and data validation for imported contacts. Security testing follows common web application risk categories and includes access-control verification and logging completeness checks [5-7].

KPI EVALUATION AND DISCUSSION

To evaluate impact, KPIs are measured before and after deployment using timestamped events and consistent definitions. Operational KPIs include average enquiry response time, lead-to-trial conversion time, scheduling error rate, and attendance capture completeness. Financial KPIs include the share of overdue payments, revenue per active learner, and the renewal rate. The system enables cohort-based analysis (age group, level, teacher) and supports management interventions through early-warning signals (upcoming expiry, repeated absences) [1, 3, 8].

The proposed approach demonstrates that consolidating CRM, scheduling, subscriptions, and payments within an integrated architecture can materially reduce administrative workload and improve data accuracy. Future work includes advanced analytics (e.g., dropout prediction), support for multi-branch operations, and tighter integration with learning content platforms [2, 8].

СПИСОК ВИКОРИСТАНОЇ ЛІТЕРАТУРИ

1. UNESCO. Digital learning and transformation of education : policy guidance. — Paris : UNESCO, 2023. — URL: <https://www.unesco.org/> (date of access: 11.02.2026).
2. Salesforce. CRM basics: managing customer relationships and service processes [Electronic resource]. — 2024. — URL: <https://www.salesforce.com/> (date of access: 11.02.2026).
3. ISO 21001:2018. Educational organizations — Management systems for educational organizations — Requirements with guidance for use. — Geneva : International Organization for Standardization, 2018. — URL: <https://www.iso.org/standard/66266.html> (date of access: 11.02.2026).
4. Regulation (EU) 2016/679 of the European Parliament and of the Council of 27 April 2016 (General Data Protection Regulation). — Official Journal of the European Union, 2016.
5. OWASP. OWASP Top 10:2021 — The Ten Most Critical Web Application Security Risks [Electronic resource]. — 2021. — URL: <https://owasp.org/Top10/> (date of access: 11.02.2026).

6. Souppaya, M.; Scarfone, K.; Dodson, D. Secure Software Development Framework (SSDF) Version 1.1 : NIST Special Publication 800-218. — Gaithersburg, MD : National Institute of Standards and Technology, 2022. — DOI: 10.6028/NIST.SP.800-218.
7. Fielding, R. T. Architectural Styles and the Design of Network-based Software Architectures : doctoral dissertation. — Irvine : University of California, 2000.
8. Wieringa, R. Design Science Methodology for Information Systems and Software Engineering. — Berlin : Springer, 2014.

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