DIVERSE DIRECTIONS: STEERING THE FUTURE OF INNOVATIVE E-LEARNING

VOLUME 12, 2026

SIG CS@e-Learning
Unit Penerbitan
Jabatan Sains Komputer & Matematik
Kolej Pengajian Pengkomputeran, Informatik & Matematik
Universiti Teknologi MARA Cawangan Pulau Pinang

e-ISBN : 978-629-92870-0-1

SIG : e-Learning@CS
https://appspenang.uitm.edu.my/sigcs/
Publication Date : 05 - Oct - 2026

DESIGN AND DEVELOPMENT OF THE JSKM STEM INNOVATION HUB

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ABSTRACT

Lecturers from Jabatan Sains Komputer dan Matematik (JSKM) at UiTM Cawangan Pulau Pinang created the web-based JSKM STEM Innovation Hub to shift STEM education from passive learning to active engagement. The main idea of this hub is to centralized all STEM innovation products that design and develop by the lectures from JSKM. This Hub was designed, tested, and improved through an iterative process using the Agile Software Development Methodology. These tools employ a "learning while playing" strategy that combines gamification, interactive simulations, and problem-solving modules to simplify difficult English, mathematical and science and technology ideas. The platform architecture, which was developed using contemporary web technologies, was tailored for minimum hardware requirements and cross-device interoperability, guaranteeing universal accessibility across a range of age groups. The system creates a strong digital infrastructure that simplifies outreach administration, increases awareness of JSKM's community initiatives, and promotes long-term STEM engagement in schools through this iterative and adaptable development method. In addition to instructional resources, the platform centralizes activity data, future event calendars, historical activity records, and an automated inquiry system for school outreach. Cross-device interoperability and seamless operation on entry-level hardware are guarantyd by contemporary web technologies. In the end, this solution makes event handling easier and increases JSKM's visibility.

Keywords: Interactive, Agile Model, Gamified learning, Digital Portal, STEM

Introductions

STEM (science, technology, engineering, and mathematics) education is essential for advancing economic growth, technological innovation, and digital transformation. However, traditional pedagogical approaches that rely on lecture-based training frequently fail to demystify computer science ideas, mathematical logic, and complex algorithms, resulting in low long-term interest and passive student involvement (Freeman et al, 2014). Academic personnel from the Jabatan Sains Komputer dan Matematik (JSKM) at UiTM Cawangan Pulau Pinang established the JSKM STEM Innovation Hub, a centralized digital site that uses interactive learning tools to connect school communities and higher

education.

The JSKM STEM Innovation Hub, will keep activity reports, event reports, and gamified learning tools organized, updated, and archived. Through interactive problem-solving modules, students develop critical analytical thinking and sustained interest in STEM; educators have direct access to validated teaching tools and simple program registration processes; and university administrators benefit from increased public visibility for Corporate Social Responsibility (CSSR) efforts, secure user authentication, and well-organized records of all departmental outreach initiatives (Liston, 2023).

Methodology

The JSKM Stem Innovation Hub project uses the Agile Software Development Methodology, an adaptable and iterative strategy that places an emphasis on adaptability, collaboration, and continuous development. Agile was selected because it works well for creating dynamic web systems, because the needs of the system may alter as a result of user input. Additionally, the Agile methodology enables incremental advancement through ongoing cycles of planning, design, development, testing, and evaluation as shown in the figure 1 below.

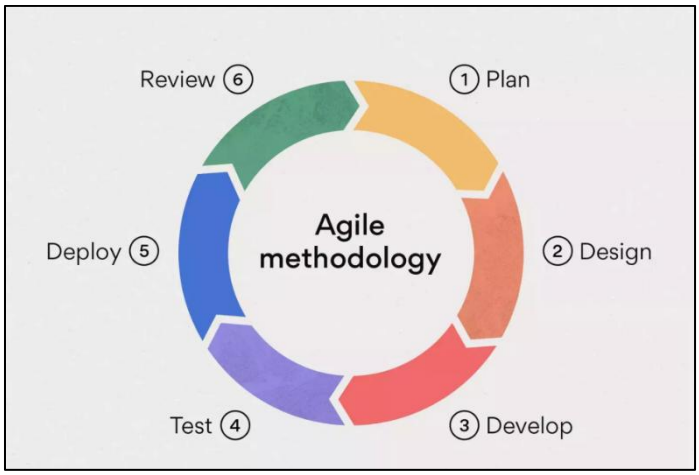

Figure 1: Agile Methodology

Note. Reprinted from *Agile methodology*, by N. Duraisamy, 2023, LinkedIn

Adapted from:(https://www.linkedin.com/pulse/agile-methodology-nirmala-duraisamy/).

The operational deployment of Agile within the JSKM STEM Innovation Hub yields quantifiable advantages, notably the mitigation of technical and financial risk through early-stage empirical validation (Abbas et al., 2008). Furthermore, it accelerates the delivery of functional educational assets and dismantles disciplinary silos, fostering cross-domain synergy across computer science, mathematical sciences, and engineering disciplines.

System Design and Architecture

The system has a three-tier architecture, with the presentation layer (frontend), the application layer (backend), and the data layer. This system is intended to highlight the goods created by JSKM from UiTM Pulau Pinang and to demonstrate previous instances of the products being used. It allows JSKM members to share events and merchandise. In order to guaranty that only JSKM members are permitted to register and log in, administrators can additionally authorize posts and generate unique IDs. Finally, visitors can use an email contact system to ask questions about events or merchandise. The overall architecture for developing JSKM STEM Innovation Hub consists of the following components:

- Frontend (Presentation Layer):
  Developed using HTML, CSS, and JavaScript, this layer handles all user interactions and displays dynamic content rendered by Django templates. It ensures responsive design and intuitive navigation across devices.
- Backend (Application Layer):
  Powered by the Django web framework (Python), the backend handles logic, authentication, data processing, and communication between frontend and database. Django's Model-View-Template (MVT) architecture was used to maintain separation of concerns.
- Database (Data Layer):
  The system uses SQLite as its database for data persistence. It stores all relevant records including members, events, products, images, and inquiries.

The system defines three main user roles: the Product Owner, the Administrator, and the General User. The Product Owner completes a standardized form to upload details about their STEM innovation product to the hub platform. The Administrator, who manages the platform, reviews, verifies, and approves these product submissions before publication. Additionally, the Administrator responds to inquiries submitted by General Users. General Users have read-only permissions to view published product information and can submit questions to the Administrator for further details.

Figure 2 show the storyboard to add a product in the JSKM STEM Innovation Hub, the Product Owner must register and login as a member with a unique ID. Then, navigate to the Products tab in the member side and fill in the details. The Product Owner must fill in all the details in the form. After filling in and submitting it, Product Owner must wait until the product is approved by the Administrator. After approval, the Product post will appear in the Products list page for all users of the website to see.

Figure 2: Storyboard for JSKM STEM Innovation Hub for Product Owner

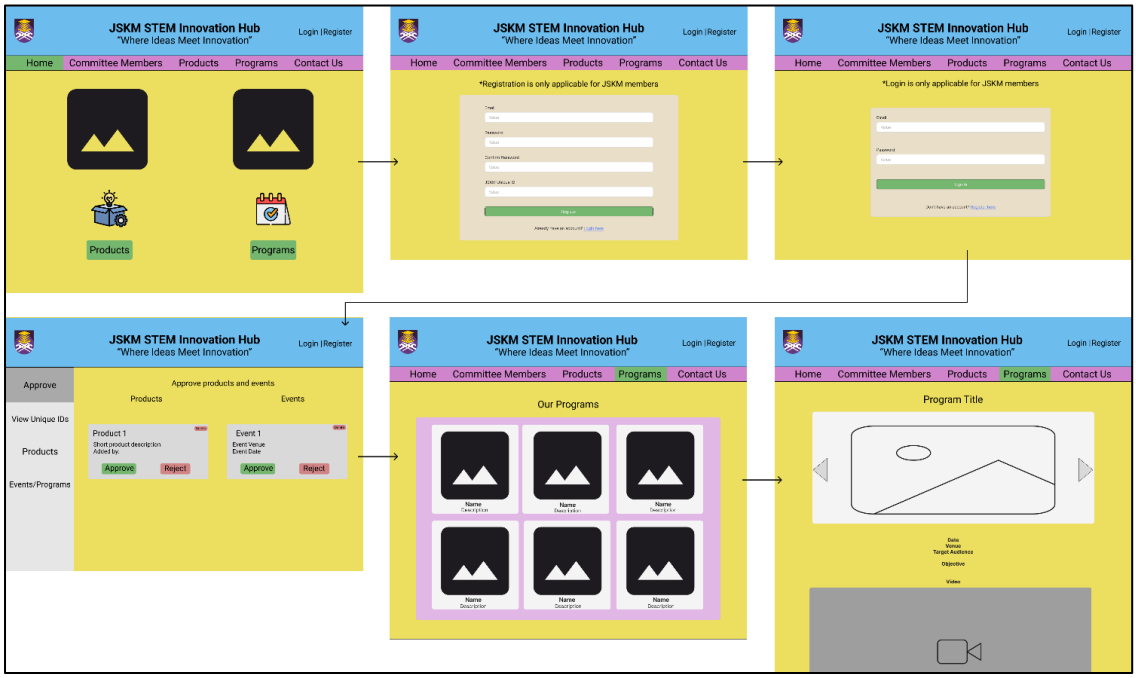

Figure 3: Storyboard for JSKM STEM Innovation Hub for approving product registration by Administrator

Approving programs takes place after logging in as a Administrator, the member capable of approving or rejecting posts by Product Owner as shown in Figure 3. The Administrator then looks at the programs waiting to be approved, then clicks on the approve button. The approved program will then be displayed on the programs list page, allowing all users to click on it and look at the details.

Figure 4: Storyboard for JSKM STEM Innovation Hub for fill up the Contact Us form

Figure 4 above show how General User can navigate to the Contact Us page by clicking on the tab below the header. The u General User will then be directed to the Contact Us page where they can fill in the details, along with their message. After clicking the 'Send Message' button, user will be prompted a thank you message and to wait for a reply in their email.

Conclusion

In order to transition STEM education from passive instruction to active digital engagement, JSKM STEM Innovation Hub waw innovate by lectures from JSKM at UiTM Cawangan Pulau Pinang. The hub centralizes historical activity archives, future event scheduling, activity reports, and an automated inquiry submission mechanism for school outreach in addition to providing interactive instructional resources. The JSKM STEM Innovation Hub is designed for high accessibility and ease of use, operating through standard web browsers on desktops, tablets, and smartphones without requiring high-end hardware or software installations. A core feature of the platform is a dedicated outreach module that enables school teachers to directly contact JSKM lecturers to plan, customize, and schedule future STEM events for their schools. By viewing past activity reports and available teaching products on the hub, educators can assess suitable modules and submit formal event requests in a single, streamlined process. This direct communication channel simplifies administrative logistics, allowing schools and university lecturers to collaborate efficiently on tailored educational programs.

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