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BLENDED LEARNING: A PRAGMATIC APPROACH TO SMART TECHNOLOGY USER TRAINING

The rapid establishment of the information society is fundamentally reshaping the interaction between regional infrastructure and its inhabitants. Across the globe, the implementation of "smart region" and "smart city" technologies has become highly relevant, driven by the need to enhance service quality, optimize resource consumption, and foster better societal communication. The essence of the smart concept lies in the effective integration of physical, digital, and human systems – utilizing Information and Communication Technologies (ICT), the Internet of Things (IoT), and Big Data – to make traditional services more efficient, sustainable, and inclusive for citizens. However, this transformative shift brings a critical and often overlooked challenge: the successful adoption and maximization of benefits from these complex, rapidly evolving digital systems depend directly on the knowledge and competence of the end-user.

The sophisticated nature of technologies like RFID, Smart Grid, smart light systems, and digital retail solutions (Smart Retail/Future Supply Chain) means that they can be overly complex for the average resident. Full mastery of their operational characteristics is hindered by their sheer variety, continuous rapid updates, and the user's limited time resources. When citizens encounter difficulty or incomprehension, they can enter a "fear zone," leading to underutilization of smart infrastructure, negative perceptions of innovation, and resistance to further digitalization efforts. A massive negative impulse from the public can significantly slow or even halt the introduction of new, energy-efficient, and sophisticated urban management systems.

Therefore, the education for consumers – a specialized type of educational service – is an indispensable, obligatory element of smart city management. This system is specifically designed to transition users from the "fear zone" to a "learning zone" and ultimately into a "comfort zone," where they can confidently and rationally consume and benefit from high-tech goods and automated control systems. The goal of this User Education System is not merely to satisfy curiosity but to ensure that the public gains the minimum necessary knowledge to understand the product's essence, appreciate its advantages, and engage in responsible and rational resource consumption. This full and informed use of technology provides users with maximum utility and encourages further interest, which in turn benefits manufacturers and system implementers.

The proposed concept for this education is rooted in informal and non-formal education, emphasizing principles of learning based on current needs, connection with real life, and flexible, short-term programs. Such educational modules must be highly responsive to user requirements, geographically and temporally unconstrained, and utilize innovative teaching methods, contrasting with the slower, more rigid structure of formal education.

The establishment of an effective User Education System requires a robust organizational and collaborative structure, which is best provided by the Quadruple Helix (QH) Model. This framework, which integrates Academia, Business (Industry), Government, and Civil Society (The Public), provides the necessary platform for harmonizing the interests of all stakeholders involved in smart city development and operation. Academia (Universities and Research Institutes) – Serves as the primary curriculum developer and intermediary in the User Education System. Leveraging their expertise in knowledge transfer and educational design, universities can develop and deploy the necessary short-term training modules for smart product users. Business (Industry) – Acts as the initiator and content partner. Facing the problem of underutilized products and customer resistance due to lack of knowledge, businesses are directly invested in the widespread success of user training. By cooperating with Academia, they provide the real-world context, product specifications, and direct feedback, ensuring the training modules are relevant and practical. Government (Public and Local Authorities) – Serves as the regulator, coordinator, and systemic beneficiary. Government bodies, including digital transformation ministries and local authorities, are responsible for developing the necessary innovation and information infrastructure. Their role is crucial in promoting the education system as an obligatory subsystem of smart city management. Society (Consumers and Civil Society) – Represents the primary customer, feedback mechanism, and ultimate driver of demand. The successful adoption of the User Education System empowers consumers, fulfilling the bottom-up interaction principle of the QH model [1].

The high flexibility, rapid adaptation, and focus on maximizing synergistic effects inherent in the QH model make it the ideal conceptual framework to ensure the User Education System is harmoniously implemented and delivers sustainable benefits across all sectors.

To effectively train the primary target audience of the User Education System – employed adults who are solvent but have limited time resources – the traditional classroom model is insufficient. The most suitable and efficient educational approach is Blended Learning (BL). BL is defined as the thoughtful combination of traditional face-to-face instruction with distributed learning systems [2].

The adoption of BL for smart city user education offers compelling benefits:

- Flexibility and Efficiency. Users can access self-paced web-based courses and learning materials at their own convenience, optimizing their time. This allows large groups to be trained simultaneously, ensuring cost-effectiveness;
- Enhanced Engagement. Face-to-face meetings can be strategically utilized for creative and collaborative activities, social interaction, and building the necessary trust and connection between users and instructors;
- Tailored Content. BL integrates multiple technologies and tools, allowing for the delivery of constantly updated, interactive, and tailored content relevant to the latest smart systems;
- Skill Development. The model inherently promotes the development of essential digital skills, self-motivation, and self-responsibility necessary for navigating a digitized world [2].

However, the success of BL is contingent upon addressing challenges such as ensuring a user-friendly learning environment and technology, maintaining high-quality and constantly updated learning content, and fostering social interaction to prevent learner isolation. The effective design of BL programs requires a focus on strong interactions (learner-to-learner and learner-to-teacher), high-quality technology that is simple to use, dedicated face-to-face support to build social connections, and robust Learning Management System (LMS) tools for easy access to resources.

In conclusion, the User Education System, structurally supported by the Quadruple Helix Model and methodologically delivered through Blended Learning, is not an optional accessory but a foundational prerequisite for the sustainable and successful development of smart cities and regions. It addresses the critical human factor, ensuring that complex technologies are embraced, utilized to their maximum potential, and ultimately contribute to a more comfortable, efficient, and sustainable society.

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