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The Role of Robots and Drones in the Future of Education and Library and Information Science

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Abstract: ***The development of robotics, artificial intelligence, autonomous systems, drones, the Internet of Things, and digital information technologies is transforming education and Library and Information Science (LIS). Robots and drones are increasingly moving beyond industrial applications and becoming tools for teaching, learning, information management, library services, research, and experiential education. This paper examines the emerging and potential roles of robots and drones in the future of education and Library and Information Science. It reviews relevant scholarly literature concerning educational robotics, drone-integrated learning, intelligent libraries, robotics in libraries, and the development of technology-oriented LIS curricula. In libraries, robots can support information desks, navigation, book transportation, shelving assistance, educational programmes, user engagement, and selected routine operations. Drones may have future applications in large-scale collection monitoring, campus or library-site mapping, emergency assessment, digital documentation, and geographically based information projects, subject to applicable safety, privacy, and legal requirements. challenges including cost, infrastructure, technical skills, privacy, data governance, cybersecurity, safety, accessibility, maintenance, ethical issues, and the possible displacement of routine tasks. It argues that future LIS professionals will require interdisciplinary competencies in AI, robotics, data literacy, digital ethics, human–robot interaction, information security, and emerging technologies. The paper concludes that robots and drones should be regarded not as replacements for teachers or librarians but as technological tools that can augment human expertise and improve educational and information services when implemented responsibly.***

Keywords: Robotics, Drones, Education, Library and Information Science, Artificial Intelligence, Smart Libraries, Educational Technology, Information Services, Digital Transformation, Human–Robot Interaction

1. Introduction

Technology has become an important component of modern education and Library and Information Science. The development of artificial intelligence, robotics, drones, cloud computing, the Internet of Things, big data, virtual reality, augmented reality, and automated information systems is creating new opportunities for educational institutions and libraries.

Among these emerging technologies, robots and drones have considerable potential because they connect the digital world with physical environments. Robots can interact with learners, perform selected physical tasks, provide information, and participate in educational activities. Drones, which are unmanned aerial systems, can provide aerial observation, mapping, photography, environmental data collection, and experiential learning opportunities when operated under appropriate safety and regulatory conditions. Similarly, research on drones in education indicates that drone-integrated learning has been particularly prominent in STEM subjects. A systematic review of drone education identified experiential learning, project-based learning, teamwork, and hands-on activities as important pedagogical approaches.

The implications extend to Library and Information Science. Libraries are increasingly becoming technology-enabled environments in which automation, artificial intelligence, robotics, digital repositories, discovery systems, and data services coexist with traditional information services. Research reviewing robotics in libraries has identified applications in educational and promotional activities as well as other library functions. Therefore, understanding the role of robots and drones is important for educators, librarians, LIS educators, researchers, administrators, and students preparing for future technology-oriented professions. The traditional educational environment has generally depended on teachers, textbooks, classrooms, laboratories, libraries, and physical learning resources. Digital transformation has expanded this environment through computers, mobile devices, online learning platforms, electronic resources, virtual classrooms, and artificial intelligence.

Robots: A robot may be understood as a programmable machine capable of sensing, processing information, and performing physical or interactive actions. In education, robots may function as:

- Learning tools
- Programming platforms
- Teaching assistants
- Interactive information providers
- Demonstration devices
- Social-interaction platforms
- STEM learning resources
- Accessibility-support tools

Research has identified applications of educational robots in language education, robotics education, teaching assistance, social-skill development, special education, and guided learning through feedback.

Drones: Drones are unmanned aerial systems that can be remotely controlled or operate with varying levels of automation. Their educational uses can include:

- Geography education
- Environmental observation
- STEM projects
- Photography and documentation
- Surveying concepts

- Disaster-management education
- Agricultural and environmental studies
- Project-based learning

In educational settings, drone activities must always be conducted by appropriately trained and supervised individuals and in accordance with applicable laws, institutional policies, and safety requirements.

2. Objectives

The major objectives of this study are:
- To examine the role of robots in modern and future education.
- To examine the potential educational applications of drones.
- To investigate the emerging applications of robots in libraries.
- To identify potential applications of drones in Library and Information Science.
- To examine the relationship between robotics, artificial intelligence, and smart libraries.
- To identify emerging competencies required by future LIS professionals.
- To examine ethical, privacy, safety, and cybersecurity issues.
- To identify major challenges associated with implementing robotics and drone technologies.
- To propose a conceptual framework for integrating robots and drones into education and LIS.
- To suggest directions for future research.

3. Role of Robots in Future Education

3.1 Robots as Teaching Assistants

Robots can support teachers by performing selected repetitive or interactive functions. Examples include:
- Delivering programmed learning activities
- Providing practice exercises
- Giving basic feedback
- Demonstrating scientific concepts
- Supporting language-learning activities
- Conducting interactive quizzes
- Assisting laboratory demonstration

3.2 Robotics and STEM Education

Robotics provides a practical environment in which students can connect theoretical concepts with physical systems. Students can learn:
- Programming
- Mathematics
- Physics
- Electronics
- Engineering design
- Computational thinking
- Problem-solving
- Algorithmic thinking
- Logical reasoning

3.3 Computational Thinking

Robotics can help students develop:
- Decomposition
- Pattern recognition
- Algorithms
- Logical reasoning
- Sequencing
- Problem-solving

3.4 Language Learning

Interactive robots may support language education through:
- Conversation practice
- Pronunciation activities
- Vocabulary exercises
- Question-answer interactions
- Role-based learning
- Repetition and feedback

4. Role of Drones in Future Education

4.1 STEM Learning

Drones can combine:
- Mathematics
- Physics
- Computer science
- Engineering
- Geography
- Environmental science

Students can study concepts such as distance, coordinates, mapping, motion, sensors, data collection, and spatial information.

4.2 Career Awareness

Drone-related education can introduce students to interdisciplinary career fields such as:
- Geographic information systems
- Remote sensing
- Environmental science
- Engineering
- Robotics
- Data analysis
- Computer science
- Digital mapping

5. Robots in Library and Information Science

Robotics has an emerging role in libraries. A review of robotics applications in libraries found that robots have been used in areas including educational and promotional activities, while the broader LIS literature remains comparatively limited.

5.1 Robotic Information Desk

An interactive robot may provide basic information such as:
- Library opening hours
- Location of sections
- Service information

- Event schedules
- General directions
- Frequently asked questions

Complex reference questions should continue to be handled by qualified library professionals.

5.2 Book Transportation

Robotic systems can potentially transport books and other materials between designated locations. Possible applications include:

- Movement of returned books
- Transportation between floors
- Internal document delivery
- Movement of materials from processing areas

5.3 Shelf Monitoring

Robotic systems equipped with sensors or cameras may assist with identifying:

- Incorrectly shelved materials
- Empty shelf locations
- Book-location discrepancies
- Selected inventory problems

Research on intelligent libraries has identified robotic applications related to book detection and shelving, although technical challenges remain around localization, gripping, and human–robot interaction.

5.4 Library Orientation

Robots can be used during student orientation programmes to introduce:

- Library sections
- Digital resources
- E-books
- Databases
- Reference services
- Library rules
- Information-literacy programmes

5.5 Robotic Promotion and Outreach

Libraries can use robots as demonstration tools during:

- Technology exhibitions
- Library weeks
- Innovation programmes
- School outreach
- STEM activities
- AI literacy programmes

6. Role of Drones in Library and Information Science

The application of drones in LIS is less developed than robotics, but several conceptual possibilities exist.

6.1 Digital Documentation

Drones may support institutional documentation of:

- Buildings
- Heritage structures
- Campus development
- Outdoor events
- Environmental conditions

6.2 Digital Heritage and Archives

Drones may contribute to digital heritage projects by collecting aerial imagery of appropriate historical or cultural sites.

- Metadata creation
- Digital preservation
- Cataloguing
- Digital repository management
- Access management
- Copyright and rights documentation

7. Smart Libraries and Robotics

The future library may increasingly operate as a **smart information environment**.

A conceptual smart-library ecosystem can include:
Users → Digital Interface → AI System → Library Management System → Robotic System → Physical Resources

For example:

- A user searches for a book.
- The information system identifies its location.
- A robotic system assists with locating or transporting the material.
- The user receives information through a digital or physical interface.
- The librarian remains available for advanced information support.

IFLA has noted that AI can support areas such as information discovery, knowledge organization, and selected library workflows while emphasizing ethical considerations, privacy, equity, and professional responsibility.

8. Artificial Intelligence, Robots and Libraries

Robotics becomes considerably more powerful when combined with artificial intelligence. AI can provide:

- Natural-language interaction
- Speech recognition
- Image recognition
- Recommendation systems
- Data analysis
- Predictive functions
- Automated classification
- Intelligent search

Robotics provides the physical interface.

Therefore:
AI = Intelligence and decision support
Robotics = Physical action and interaction
Library Information System = Information infrastructure
Librarian = Human expertise, ethics, interpretation and professional judgment

The integration of these components can contribute to the development of intelligent library environments.

9. Robotics and the Future LIS Curriculum

The growth of AI and robotics creates a need to reconsider LIS education.

Research examining LIS curricula has identified opportunities for greater integration of AI, robotics, data, digital technology, and information ethics into professional education.

Future LIS programmes may include subjects such as:

Proposed Subject Areas
- Artificial Intelligence in Libraries
- Robotics in Library Services
- Internet of Things and Smart Libraries
- Data Science for Information Professionals
- Human–Robot Interaction
- Information Security
- Cybersecurity and Privacy
- Digital Preservation
- GIS and Spatial Information
- Drone-Based Information Collection
- AI and Information Literacy
- Digital Ethics
- Automation and Library Management
- Emerging Technologies in LIS
- Programming Fundamentals for Librarians

10. Robotics Literacy and Information Literacy

The concept of information literacy is expanding. Traditionally, information literacy involves the ability to:
- Identify information needs
- Locate information
- Evaluate information
- Use information ethically
- Communicate information

In an AI- and robotics-enabled environment, learners may additionally need to understand:
- How AI systems generate information
- How automated systems make decisions
- How sensors collect data
- How robotic systems interact with users
- How data can be stored and processed
- How algorithms can contain limitations or bias

Recent educational robotics research has proposed broader "robotics literacy" involving technological, computational, engineering, AI, and socio-ethical dimensions. Libraries can therefore become important centres for robotics, AI, and information literacy.

11. Advantages of Robots and Drones in Education and LIS

The major potential advantages include:

11.1 Automation: Robots can perform selected repetitive tasks.

11.2 Engagement: Interactive technologies can increase learner participation in suitable activities.

11.3 Accessibility: Some robotic systems can provide additional modes of interaction.

11.4 Efficiency: Automation may improve selected routine workflows.

11.5 Innovation: Technology-rich libraries can become innovation and learning centres.

11.6 Career Development: Students gain exposure to emerging technologies and interdisciplinary career areas.

Future Smart Library
A future smart library may contain the following components:

Component	Possible Function
AI chatbot	Basic user enquiries
Robotic information assistant	Physical interaction and directions
RFID/automated systems	Collection identification
Robotic transport	Internal movement of materials
AI discovery system	Intelligent information retrieval
Digital repository	Long-term digital access
Sensors/IoT	Environmental monitoring
Data analytics	Service planning
Drone technology	Selected mapping/documentation applications
Librarian	Expert information and research support

The model should be implemented according to institutional needs, available resources, ethical standards, and applicable regulations.

12. Role of Libraries in AI and Robotics Literacy

Libraries are not merely users of emerging technologies. They can also educate communities about them.
Libraries can organize:
- AI literacy workshops
- Robotics demonstrations
- Coding programmes
- Drone-awareness programmes
- Information-security awareness
- Digital ethics sessions
- Research-data literacy
- STEM activities
- Emerging-technology exhibitions

IFLA's recent work on libraries and AI literacy highlights the potential role of libraries in developing equitable AI literacy and helping communities understand AI and its social implications. Thus, the library can become a community technology and information-literacy centre

13. Conclusion

Robots and drones represent important components of the emerging technological ecosystem of education and Library and Information Science. Their importance extends beyond automation. Robots can create interactive learning environments, support selected library services, facilitate user engagement, and contribute to smart-library development. Drones can provide opportunities for experiential learning, mapping, environmental studies, geography, and selected forms of digital documentation. The literature indicates that educational robotics is increasingly connected with computational thinking, programming, project-based learning, and broader robotics literacy. Drone-integrated education similarly demonstrates potential for experiential and collaborative learning. In LIS, robotics is an emerging area with applications in information services, collection-related activities, educational programmes, and smart-library environments. However, technology alone does not guarantee educational or library improvement. Successful implementation requires appropriate infrastructure, trained professionals, financial planning, accessibility, cybersecurity, privacy protection, safety, ethical governance, and continuous evaluation. The future library should therefore not be understood as a fully automated institution. Rather, it should be viewed as a human-centred intelligent information environment in teachers, students, AI systems, robots, drones, digital resources, and information infrastructures work together. “Technology should augment human knowledge, not replace human judgment. “For future LIS professionals, understanding robots, drones, AI, data, and emerging technologies will increasingly become part of professional technological literacy. Libraries can also play an important role in helping society understand these technologies critically, ethically, and responsibly.

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