DESIGN CONSIDERATIONS FOR SEMI-AUTONOMOUS ROBOT ASSISTANCE IN HIGHER EDUCATION

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DEFINITIONS

- **Robot Assistant**
  – A robot designed to assist humans in various tasks, improving efficiency and effectiveness in both professional and personal contexts [24].

- **Semi-autonomous Robot Assistant**
  – A robot that operates with some degree of autonomy but still requires human intervention for complex tasks or decisions [25].



BACKGROUND

Higher education increasingly faces:

- **Large classes** → limited individual support for students.
- **Repetitive instructional tasks** → increased lecturer workload.
- **Administrative activities** → reduced time for teaching-related tasks.
- **Limited timely feedback** → fewer opportunities for continuous course improvement.

Robot assistants can support these activities, but existing implementations are often **isolated and task-specific**.

Problem: How can semi-autonomous robot assistance be designed more systematically for higher education?

RESEARCH GAP

Previous studies demonstrate robots for:

- Teaching and tutoring
- Telepresence and engagement
- Administrative support
- Student interaction and guidance

However, different applications are often studied independently.

Missing perspective: How robot roles, autonomy, human oversight, supporting software, and implementation conditions relate across different educational scenarios.

RESEARCH AIM

To identify and synthesize **design considerations for semi-autonomous robot assistance in higher education**.

The study considers:

- Where robot assistance can be applied
- Which tasks are suitable for robot support
- Appropriate levels of autonomy
- Human oversight and lecturer control
- Technical and organizational conditions

BASIS OF THE STUDY

The design considerations are based on:

Research basis

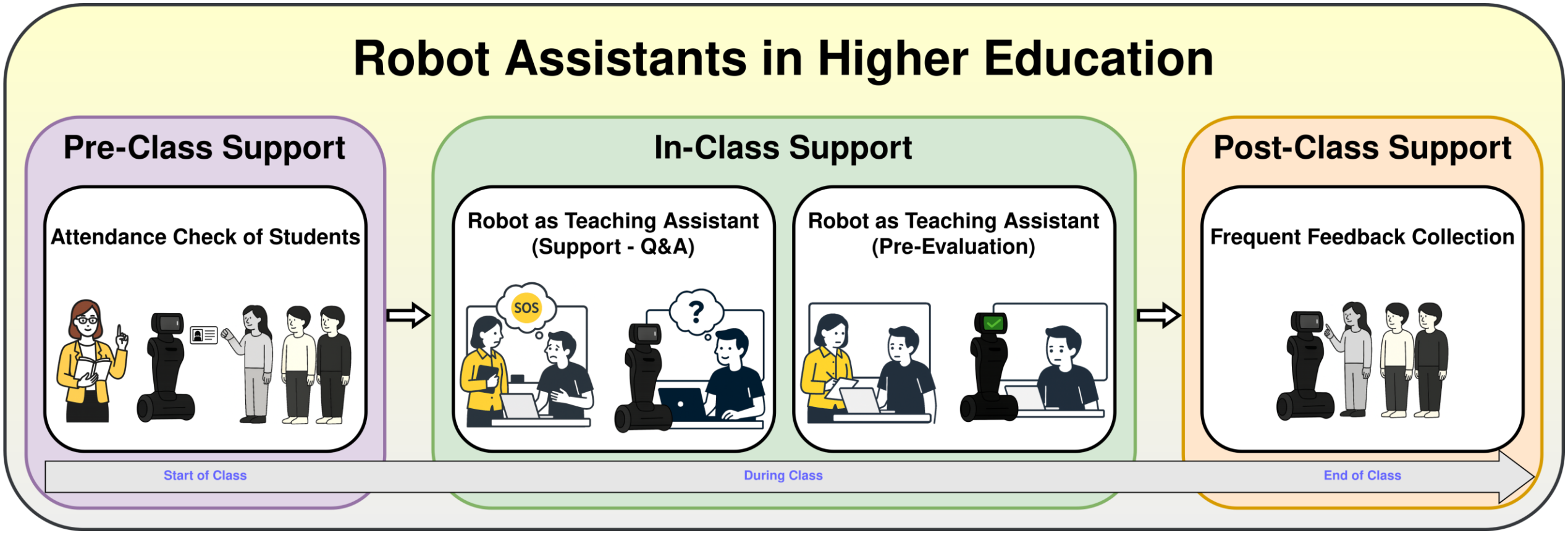
- Systematic literature review
- Existing robot and educational technology research

Classroom experience

- Attendance checking
- Q&A and student guidance
- Practical-task pre-evaluation
- Immediate feedback collection

These scenarios represent **administrative, instructional, and feedback-related support**.

ROBOT ASSISTANCE ACROSS THE TEACHING PROCESS



Key principle: Robot use should respond to a clear educational or administrative need.

AUTONOMY & HUMAN OVERSIGHT

The level of autonomy should depend on the task.

Higher autonomy

- Structured
- Repetitive
- Clearly defined activities

Greater human involvement

- Exceptional situations
- Ambiguous cases
- Pedagogically important decisions

Robot assistance should complement, not replace, lecturer responsibility.

EXAMPLE: DIVISION OF RESPONSIBILITIES

Robot can support:

- Attendance registration
- Routine Q&A
- Procedural guidance
- Preliminary task checking

Lecturer remains responsible for:

- Complex student questions
- Exceptional cases
- Final assessment decisions
- Pedagogical judgment

Design consideration: Clearly define what the robot may do independently and when escalation is required.

ROBOT & SUPPORTING SOFTWARE

The robot is only one part of the overall solution.

Robot-assisted support may involve:

- **Interaction**: voice, text, sensing
- **Intelligence**: rules, AI/LLM, analytics
- **Systems**: applications, databases, authentication
- **Service delivery**: guidance, verification, feedback, reporting

Robot functions and supporting software services should have clearly defined roles and relationships.

IMPLEMENTATION CONDITIONS

Successful integration depends on more than functionality.

Key considerations include:

- **Usability** – simple and suitable interaction
- **Reliability** – stable operation during class
- **Lecturer control** – human oversight where needed
- **Privacy & ethics** – responsible data processing
- **Institutional support** – infrastructure, maintenance, policies
- **Interaction mode** – appropriate for the classroom context

These conditions are central factors identified in the underlying framework work.

FINDINGS FROM PREVIOUS CLASSROOM STUDIES

Previous implementations showed:

- Generally positive student and lecturer acceptance
- Robot support was valued for repetitive and structured tasks
- Teaching-assistant functions achieved good perceived usability
- Interaction mode influenced user experience
- Reliability and practical usefulness strongly affected acceptance

Main observation: Users value the robot primarily when it provides **clear practical benefit**, not simply because it is a novel technology.

CROSS-SCENARIO LESSONS

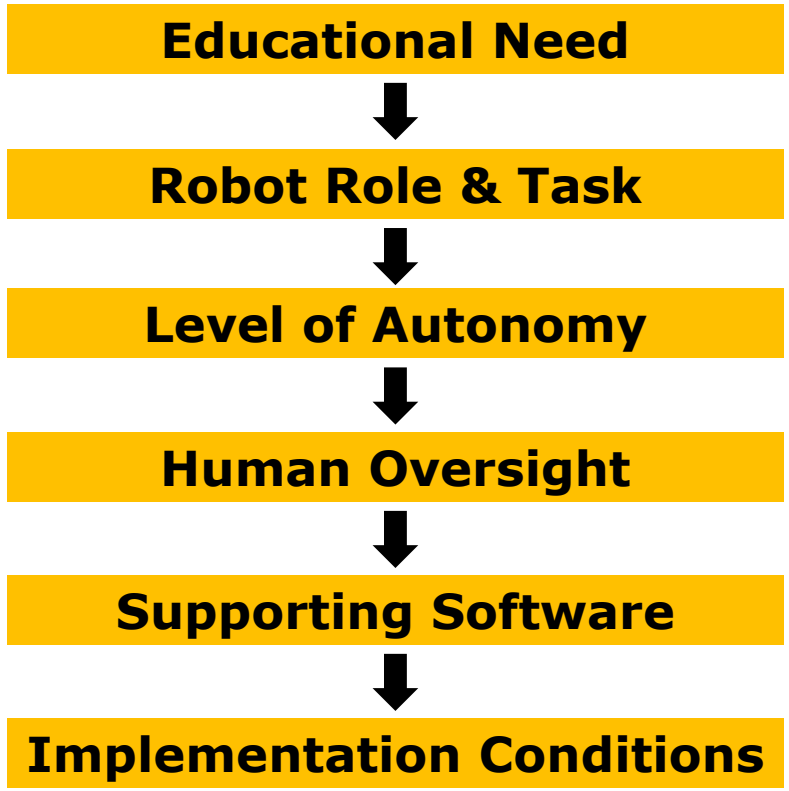
Across the different scenarios:

- Repetitive tasks are suitable candidates for robot assistance
- Complex decisions require human involvement
- Different tasks require different autonomy levels
- Reliable operation is essential for acceptance
- Robot, software, and human roles must be coordinated
- One robot configuration does **not** fit every educational scenario

MAIN CONTRIBUTION

Cross-scenario synthesis of design considerations for semi-autonomous robot assistance

The considerations connect:



This shifts attention from individual robot applications toward **systematic design across different educational tasks**.

REFINEMENT THROUGH FEEDBACK

The current design considerations will be used for discussion with researchers and practitioners.

Feedback will focus on:

- Clarity of the considerations
- Completeness of the identified elements
- Relationships between robot and human roles
- Missing implementation requirements
- Practical relevance for higher education

Purpose: identify areas requiring clarification or further refinement.

CONCLUSION

- Robot assistants can support administrative, instructional, and feedback-related activities.
- Effective integration requires more than selecting robot functions.
- **Autonomy, human oversight, supporting software, and implementation conditions must be considered together.**
- Previous classroom experience provides practical input for identifying these considerations.
- Cross-scenario analysis provides a basis for further refinement and validation.

Takeaway: The key question is not only what a robot can do, but how robot assistance should be designed to support teaching effectively and responsibly.

THANK YOU!

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Discussion

- What additional considerations are important when integrating semi-autonomous robot assistants into higher education?