Learner Models

Requirements and Legal Issues for the Development and Application of Learner Models

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Motivation

Learners become increasingly heterogeneous

Individual support, e.g. to help weaker students make up for their deficits alongside lectures, does not scale easily

No public reference architecture of an adaptive digital learning environment with a learner model

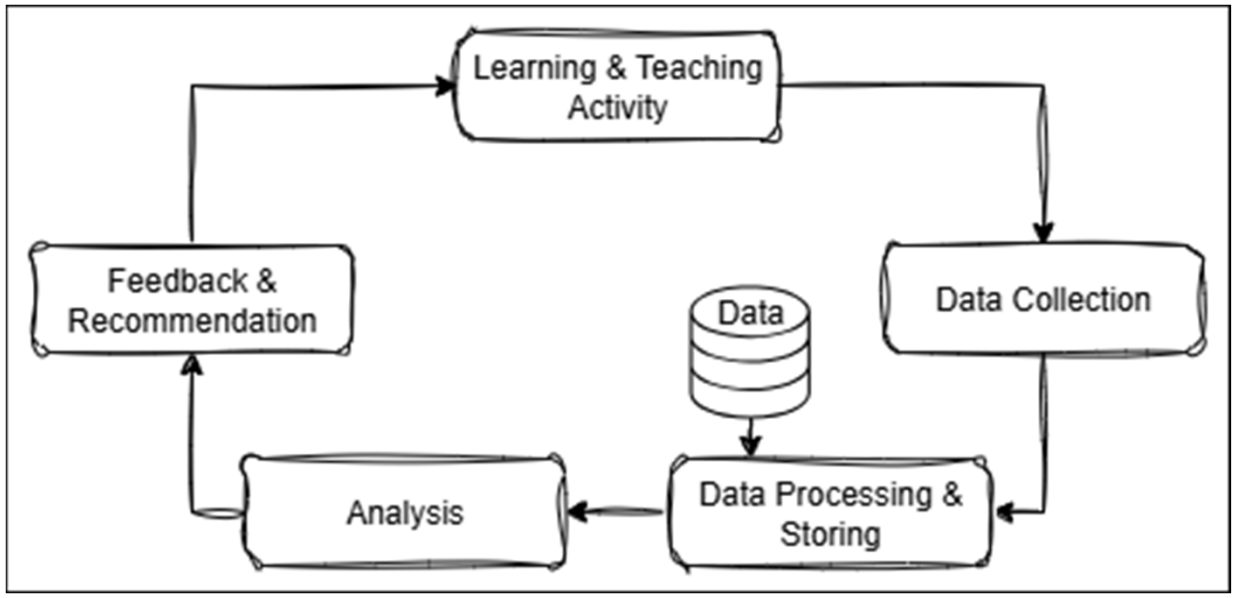
Adaptive Digital Learning Environment

How does the learner act?

Who is the learner?

What the learner might do next,
according to her individual needs

Workflow Reference Architecture



Typical Application Scenarios

Micro-Level (Learner)

- Supports personalized learning by providing customized recommendations for individual learners.

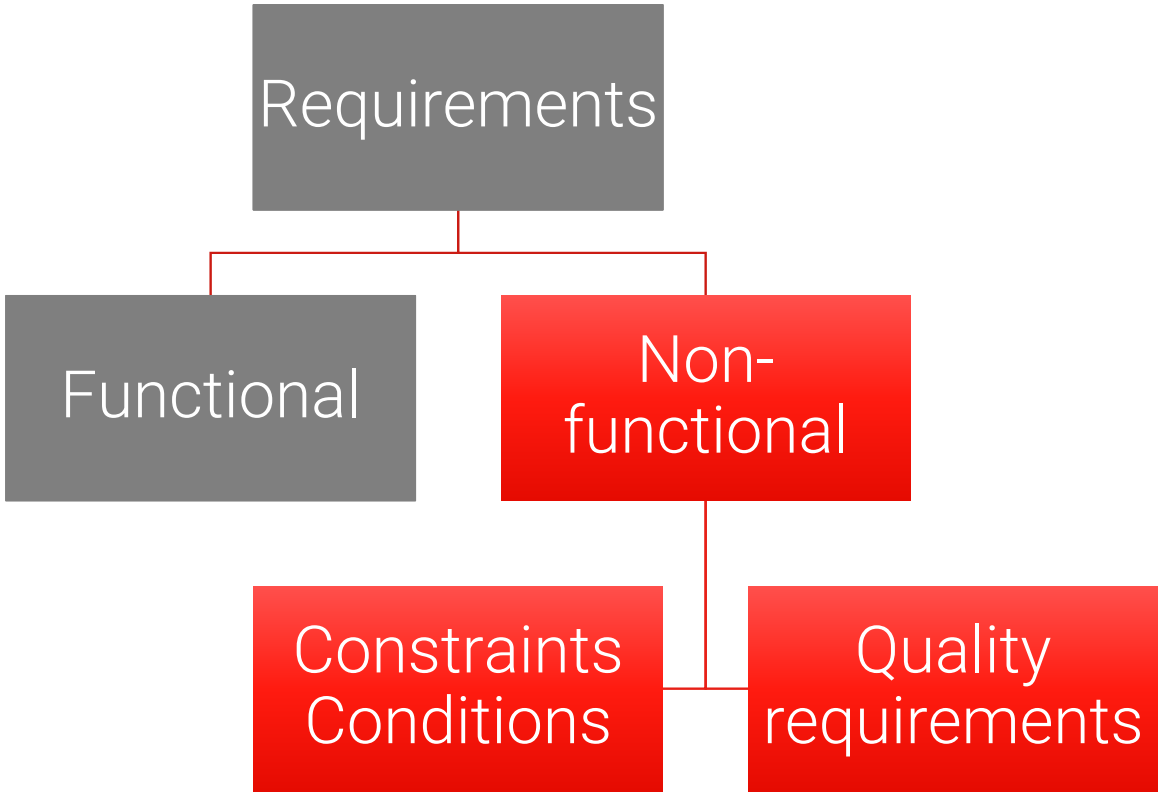
Meso-Level (Instructor)

- Helps educators identify learning behavior patterns within groups to improve teaching strategies.

Macro-Level (Educational Institution)

- Enables strategic decisions in education institutions, including study planning and barrier identification.

Scope


Requirements
Functional
Non-functional
Constraints Conditions
Quality requirements

Approach to Requirements Collection

- **Detailed Analysis of Scientific Literature and Standards**
  - Systematic literature research, covering
    - approximately 200 papers (out of ~ 3000 relevant ones) in depth
    - 16 standards / norms (out of ~ 800 relevant ones) in depth
- **Detailed Analysis of Relevant European Data Protection Regulations**
  - EU Data Act
  - EU General Data Protection Regulation (GDPR)
  - plus relevant legal publications

Technical Requirements: must-be

- **Collection and Management of Learning Data**
  - Essential requirements include collecting and managing learning and behavioral data from multiple sources securely
- **Legal Data Protection Requirements**
  - Ensuring legal compliance with GDPR focusing on purpose limitation, transparency, and data minimization

Technical Requirements: should-be

- **Transparency / Traceability**
  - Each processing step shall be transparent and understandable for learners
- **Responsibility**
  - Learners shall be able to decide which of their data may be collected
- **Fairness & Ethics**
  - Algorithms shall be free of bias and ensure equal opportunities
- **Tamper-proof**
  - Data shall be protected from unauthorized access and manipulation

Technical Requirements: could-be

- **Openness & Visualisation**
  - Learners shall be able to view and analyse their own learning data and progress
- **Negotiation Options**
  - Learners shall be able to interact with the model to question or adjust their data
- **Data Minimisation & Sustainability**
  - Only strictly necessary data shall be collected to reduce system load
- **Modularity & Flexibility**
  - Models shall be modular and flexible for integration into different systems
- **Maintainability & Expandability**
  - Models shall be easy to adapt and extend over time
- **Standardised / Interoperability & Integration**
  - Standardised formats shall ensure seamless data exchange across platforms

Legal Constraints

- **Lawfulness - Legal Bases**
  - Any data processing activity requires a valid legal basis (e.g., consent or public interest)
- **Special Categories of Data**
  - Sensitive data may only be processed under strict conditions of substantial public interest
- **Purpose limitation**
  - Data may only be used for specific, explicit, and legitimate purposes
- **Transparency**
  - Learners must be clearly informed about how their data is used

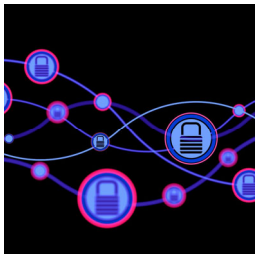
Legal Constraints

- **Data Minimisation**
  - Only the minimum of data necessary for the intended purpose may be processed
- **Storage Duration**
  - Personal data must only be stored as long as it is required for its purpose
- **Integrity & Confidentiality**
  - Data must be protected by strong technical and organisational safeguards
- **Use of Processors**
  - External processors must comply with GDPR through binding contracts
- **No Automatic Decision-Making with a Legal Impact**
  - Legally significant decisions must not be made solely by automated systems

Summary and Next Steps

Potential of Learner Models

Learner models enable personalised, efficient, and fair education tailored to diverse learner needs.



Legal and Technical Considerations

Implementation must address GDPR compliance and technical challenges to ensure transparency and fairness.

Next Steps for Development

Developing a legally compliant prototype integrated into learning platforms to create a reference model for institutions.

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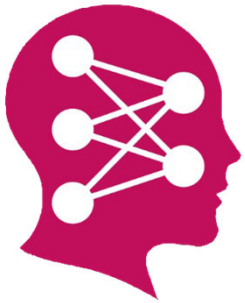

KOMP – HI

Bundesministerium für Bildung und Forschung

Bayerisches Staatsministerium für Wissenschaft und Kunst

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Questions and Remarks