Dresden University of Technology, Faculty of Computer Science

Architectural Design of an Adaptive, Structure-Aware Intelligent Tutoring System

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Background - LMS

Definition

An LMS [(Learning Management System)] is the infrastructure that delivers and manages instructional content [Watson and Watson, 2007]

Drawback

Usually LMS provide the same pedagogical resources and the same content for all the students, without considering their specific, individual needs [Giuffra Palomino et al., 2014]

Background - ITS

Definition

Intelligent tutoring systems (ITSs) are computer programs that [...] perform functions inherent to the tutorial process [...] to cause a cognitive and motivational change in the student. [Paladines and Ramirez, 2020]

Background - ITS

Features
[Sleeman and Brown, 1982]

- Be adaptive to the learner
- Interact with the learner
- Possess domain specific knowledge

Reference Architecture
[Wenger, 1987]

- Communication module
- Tutorial module
- Student module
- Expert module

Motivation

ITS are often self-contained or system-dependent

- Implemented didactic concepts cannot be easily reused
- Many LMS do not provide personalized learning content
- Learning profiles can not easily be transferred between the systems

$\Rightarrow$ **not adaptive**

Motivation

LMS are often lacking in a didactically useful representation of the structure of the learning content

- Learner may not be able to retrace assistance that is related to the structure of the learning content
- Learners may get lost in the learning-content-structure during guidance

$\Rightarrow$ **not structure-aware**

Goal

Combine the **advantages of**

- **L**earning **M**anagement **S**ystems and
- **I**ntelligent **T**utoring **S**ystems

by providing

system-independent, didactically traceable assistance

using an

adaptive, structure-aware ITS.

Considered System

In collaboration with learning experts from the Faculty of Psychology at the Dresden University of Technology [1]

Knowledge graph

- Structured overview of the learning content and the corresponding dependencies
- Supposed to make assistance traceable [Winne et al., 2019]

Chatbot

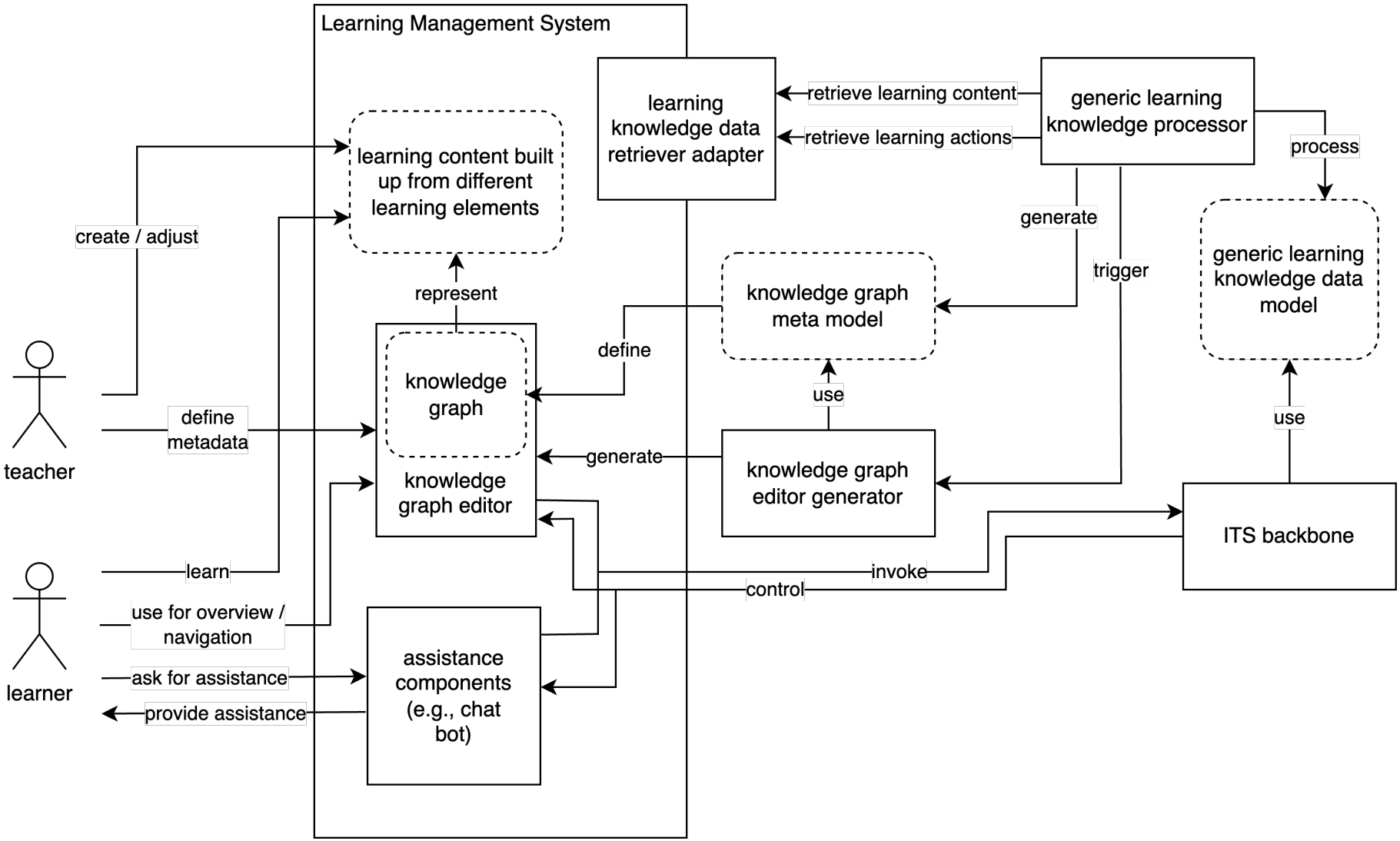
- Interaction with the learner
- Acting proactively and reactively
- Supposed to empower the learner's learning process [Winkler and Söllner, 2018]

[1] https://tu-dresden.de/mn/psychologie/ipep/lehrlern, 04/16/2023

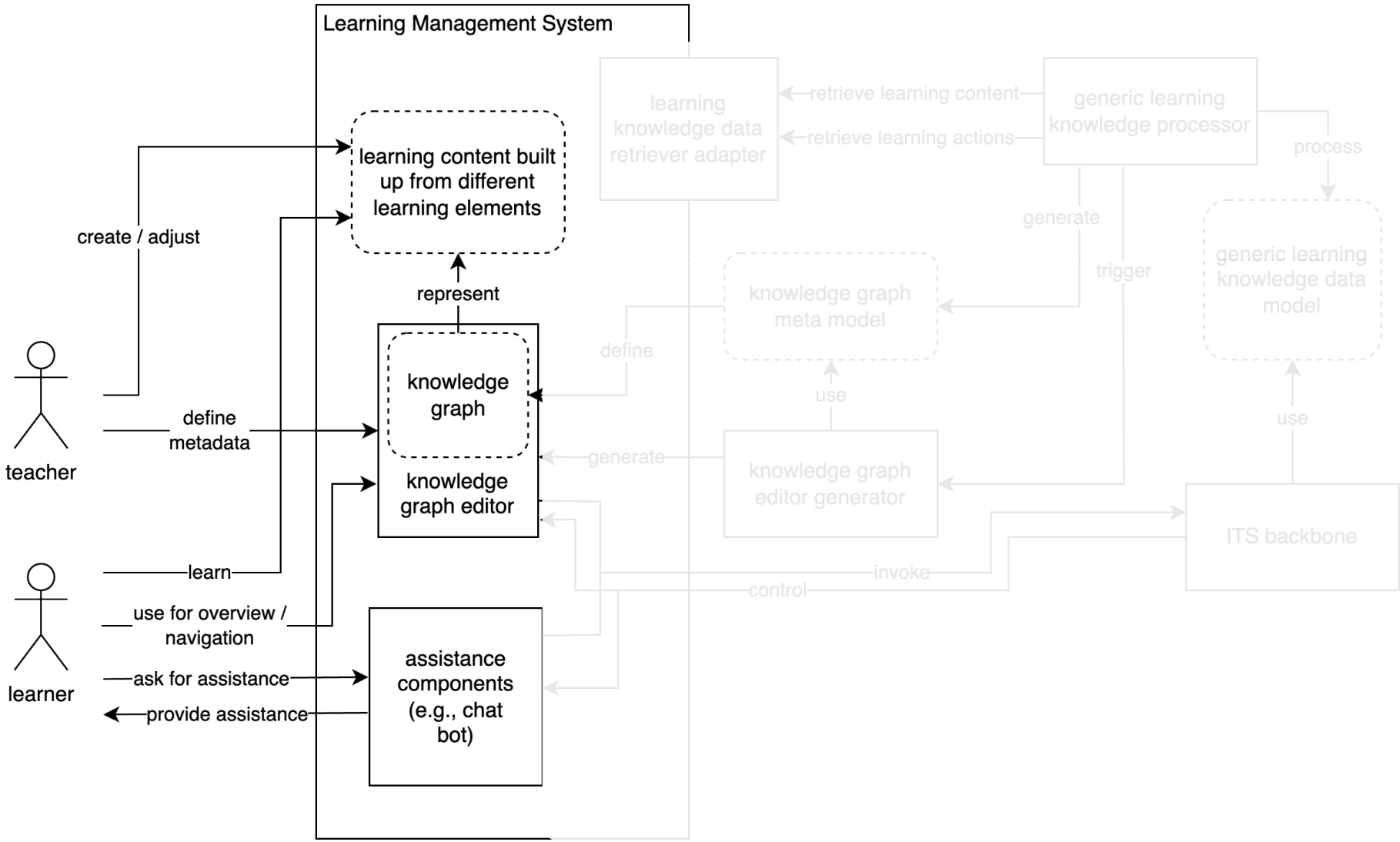
Design Challenges

- LMS-independent learning scenario support
- Heterogeneous approaches to structuring learning content
- System-independent learning knowledge data retrieval
- Generic assistance components integration

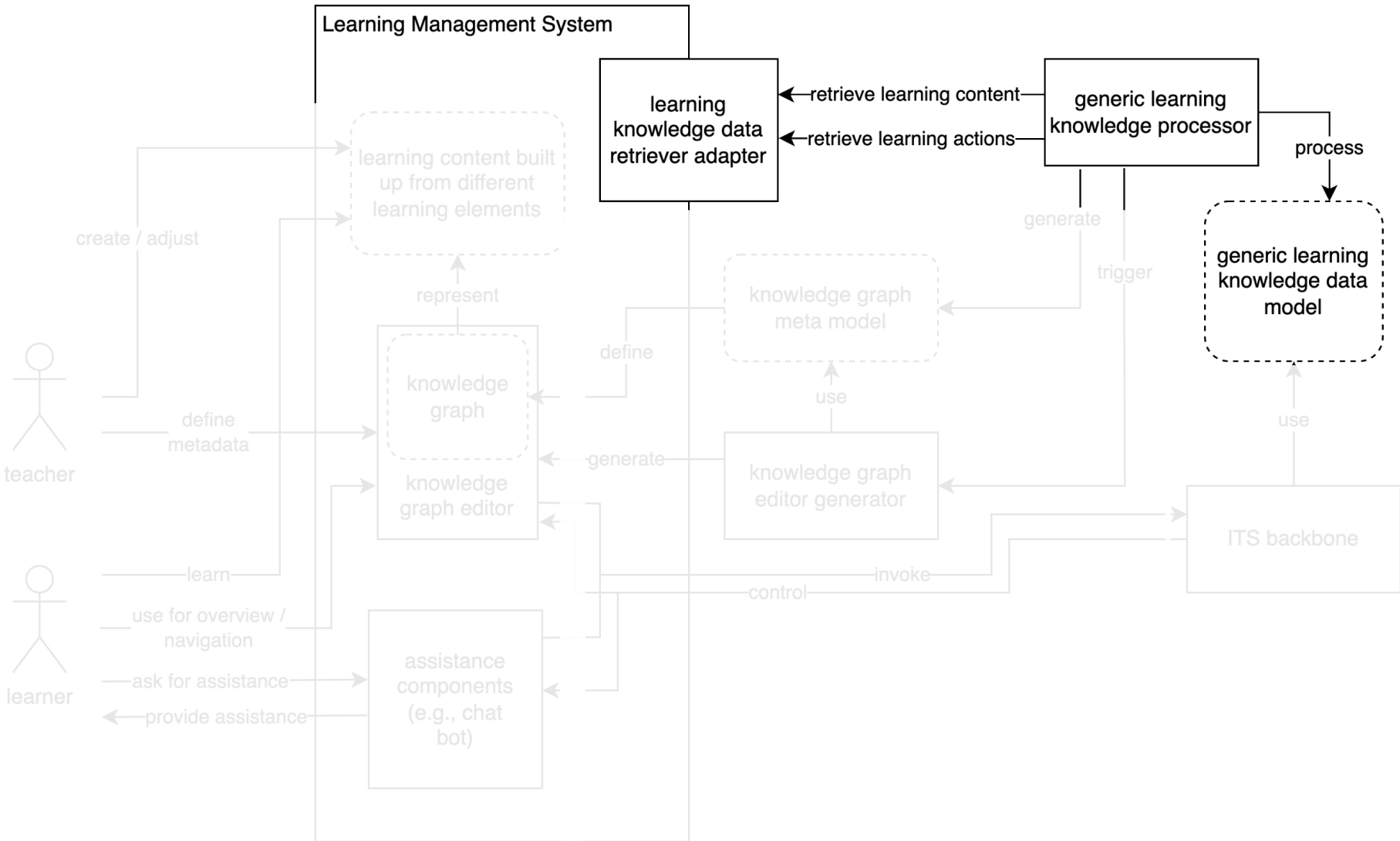
Architecture Proposal



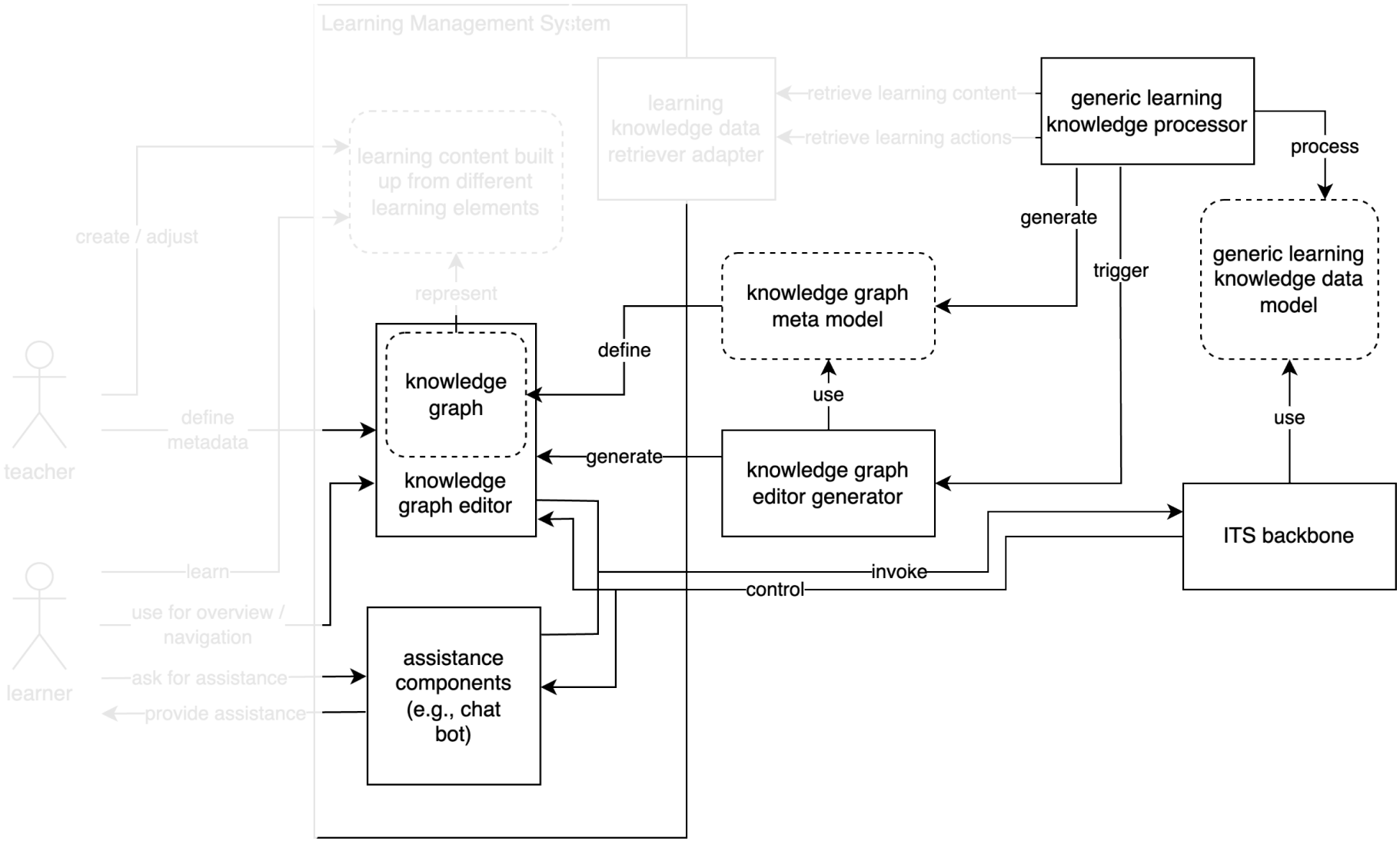
User Interaction



Data Retrieval & Representation



Data Utilization



Outcome

Learner

- Learning content is personalized
- Cross-plattform analytics can be supported [Mangaroska et al., 2021]
- Learning content overview is available

Teacher

- Existing LMS content can be used for personalized learning
- Metadata for the learning content can be defined system-independently

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Do we need a discussion?

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