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MULTIMODAL AND COGNITIVE APPROACHES TO ACADEMIC DISCOURSE IN AI-SUPPORTED LEARNING

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Abstract
This article examines how academic discourse is reshaped in higher education through the integration of artificial intelligence (AI) and multimodal design, understood here in the sense of multimodal discourse theory (not multimodal AI models). Grounded in cognitive linguistics, sociocognitive discourse theory and multimodal semiotics, the study analyzes how academic concepts are structured and communicated in AI-enhanced learning environments. It focuses on two Micromodules developed at the University of Osnabrück – *Welcome to the AI Jungle* and *Expedition AI*. Micromodules are short multimedia units suitable for Blended Learning that integrate text, visuals, interactivity, and AI-generated feedback within the Stud.IP Learning Management System (LMS). Using a combination of cognitive discourse analysis and multimodal content analysis, the study explores how learners engage with the concepts of *learning*, *argumentation*, and *autonomy* in AI-mediated contexts.

Our findings show that learners navigate content using conceptual metaphors like LEARNING IS A JOURNEY, reinforced by modular layout and AI feedback mechanisms. Argumentation is shaped through additive elaboration rather than critical opposition, while autonomy is bounded by interface cues and AI prompts. The study also analyzes how AI systems – specifically tailored to and embedded within the LMS – can participate as semiotic agents, influencing meaning-making through tone, visual presence, and structured interaction. These patterns suggest a shift toward dialogic, hybrid academic discourse in which agency is distributed across human and non-human actors. The article argues that in AI-supported, multimodal learning environments, academic literacy should be reimagined as something created through collaboration between

students, educators, and digital tools. It also highlights that developing critical digital literacy is essential for designing curricula that meet the demands of the future.

Keywords: *academic discourse, artificial intelligence, autonomy, cognition, digital literacy, multimodal learning.*

1. Introduction

Recent developments in artificial intelligence (AI) and the increasing use of multimodal learning platforms are profoundly reshaping academic communication in higher education. Traditional forms of academic discourse – rooted in lectures, essays, and formal assessments – are being redefined through tools that integrate text, image, audio, interface, and algorithmic agents. This evolution raises critical questions about how academic knowledge is construed, scaffolded, and communicated in digitally enhanced learning environments.

While prior studies have examined the role of AI in assessment (Zawacki-Richter et al., 2019), feedback generation (Chevalier et al., 2022), and digital pedagogy (Kress, 2010), relatively few have addressed the intersection of AI agency, multimodal design, and cognitive structuring of academic concepts within actual university-level instructional content. This article builds on foundational research in cognitive linguistics (Lakoff & Johnson, 1980), sociocognitive discourse theory (van Dijk, 2008), and multimodal semiotics (Kress & van Leeuwen, 2006), extending these perspectives to analyze the evolving nature of academic discourse in AI-mediated environments.

The ***subject-matter*** of this study is academic discourse as it unfolds in AI-supported, multimodal instructional modules, where meaning is constructed collaboratively between learners, educators, and algorithmic systems. The ***material*** analyzed consists of two micromodules developed at the University of Osnabrück – *Welcome to the AI Jungle* (University of Osnabrück, 2024c) and *Expedition AI* (University of Osnabrück, 2024a) – which exemplify the integration of AI-generated feedback, visual design, and modular sequencing within the LMS Stud.IP.

The article proceeds from the assumption that academic discourse is not merely a vehicle for information transfer but a cognitively and socially embedded practice. Previous research has shown that metaphoric framing (Fauconnier & Turner, 2002), interface architecture (Piwowar & Dovhaniuk, 2025), and learner feedback loops (Mousavi, Mares, & Stonham, 2015) all shape how students engage with abstract concepts such as *learning, argumentation*, and *autonomy*. However, these dynamics have not yet been critically examined in terms of how AI and multimodal design co-construct academic meaning.

The ***aim*** of the article is to investigate how AI-supported, multimodal environments reshape academic discourse at the level of concept formation, learner agency, and knowledge communication. The ***objectives*** are as follows:

- to identify the cognitive patterns that shape learners' understanding of key academic concepts in AI-integrated settings;
- to analyze the multimodal strategies used to scaffold meaning and guide learner interaction;
- to examine the discursive role of AI as an active participant in academic meaning-making.

These objectives correspond to the broader research task of redefining academic literacy in digital contexts where human and algorithmic actors collaborate. The article further aims to contribute to current debates on AI in education by emphasizing the need for critical digital literacy and reflective pedagogical design.

2. Theoretical framework

This section outlines the theoretical foundations that inform the study, combining insights from cognitive linguistics and multimodal discourse theory. These two approaches are used in tandem to analyze how academic concepts are construed and communicated in AI-supported educational settings.

2.1. Cognitive approach to discourse

A cognitive perspective on discourse emphasizes the idea that language is deeply connected to how we perceive, organize, and make sense of experience. In academic contexts, this means looking at how learners mentally structure abstract concepts through linguistic choices. The notion of construal – how language reflects different ways of viewing a situation – plays a key role in understanding how students interpret and express academic content (Langacker, 2008).

In addition, this study draws on the theory of conceptual metaphor and mental space blending, which explain how abstract academic ideas (such as "learning paths" or "argument strength") are often built from more concrete or embodied domains (Fauconnier & Turner, 2002). The sociocognitive model of discourse proposed by van Dijk (2008) is also particularly relevant here, as it highlights how context models – mental representations of communicative situations – guide language use in structured environments like classrooms or online forums.

2.2. Multimodal discourse theory

Multimodal discourse theory provides a framework for analyzing how meaning is constructed not only through language, but through the interplay of visual, spatial, and interactive modes. In digitally mediated academic environments, communication is increasingly realized across a range of semiotic resources – from layout and typography to platform architecture and learner interfaces. Drawing on the work of Kress and van Leeuwen (2006), this study adopts the view that each mode offers distinct affordances for meaning-making, and that the design of learning content like micromodules relies on the *orchestration* of these modes in pedagogically structured ways.

In this regard, the notion of 'transmedia learning' further enriches the multimodal perspective. Fleming (2013) describes transmedia learning as "*the application of storytelling techniques combined with the use of multiple platforms to create an immersive learning landscape*" (p. 371), where "*learners and content... flow seamlessly across media platforms*." This perspective is especially relevant to the micromodules, which combine textual explanations, visuals, embedded media, and interactive elements into cohesive, stepwise learning experiences. By sequencing knowledge through media transitions – such as from infographic to quiz, or from video to reflection prompt – micromodules embody a transmedia logic that promotes learner autonomy and deeper conceptual integration. These patterns highlight not only the multimodal, but also the narrative and cognitive coherence necessary in AI-enhanced academic environments

2.3. AI-Supported academic environments

The increasing use of AI tools in education adds another layer to both the cognitive and multimodal dimensions of discourse. Tools like ChatGPT and automated writing feedback systems introduce new agents and formats into the communicative process. These technologies influence not only genre and formality, but also how turn-taking, feedback, and topic development occur in real-time (Zawacki-Richter et al., 2019). Moreover, AI tools are not passive platforms; they often co-construct knowledge with users by generating suggestions, predicting learner needs, and prompting further elaboration (Jones et al., 2022). This shifts the traditional roles of teacher and student, raising new questions about authorship, agency, and the boundaries of academic voice in AI-mediated communication.

At the University of Osnabrück, AI integration is approached through a range of tools designed to support both content creation and learner interaction (University of Osnabrück, 2024b). Free and data protection-compliant access to large language models is provided through an internal platform called 'kiwi', which allows students, teachers and university staff to interact with advanced language models via their institutional accounts. In addition, an AI-powered Stud.IP plugin called AI Quiz automatically generates quiz questions based on the content presented in Courseware, which is a plugin within the LMS for multimedia-content-creation. Integrated within Courseware,

AI Quiz can be used to "chat" with the content of single pages of the units. This functionality exemplifies how AI tools can dynamically structure academic content and facilitate knowledge retrieval in ways that go beyond static instructional design.

The University of Osnabrück also employs Whisper, an AI transcription tool that converts spoken language from audio and video files into editable text. This supports inclusive learning and promotes multimodal engagement by making spoken content accessible in written form – an important consideration for both accessibility and cognitive processing. Moreover, AI-generated visuals are used to enhance learning, with text-to-image tools employed to visualize abstract concepts, metaphors, and argumentative structures. These visuals contribute to a coherent visual language across course materials, reinforcing thematic and conceptual clarity. Collectively, the active use of tools such as GPTs, AI Quiz, Whisper, and visual AI generators reflects the university's commitment to embedding AI meaningfully into instructional design. These examples demonstrate how algorithmic systems are reshaping the production, delivery, and reception of academic discourse in higher education.

The examples discussed above demonstrate how algorithmic systems are reshaping the production, delivery, and reception of academic discourse in higher education. In the following sections, we refer to these systems as exhibiting forms of AI agency – a term used to describe the perceived or functional ability of AI tools to guide, shape, or co-construct meaning within learning contexts. Likewise, we introduce the notions of semiotic actor (AI as a participant in meaning-making processes) and bounded autonomy (learner independence constrained by design cues and algorithmic scaffolding). These terms are used analytically to highlight the complex interplay of control, representation, and decision-making in AI-enhanced educational environments.

3. Method and material

This study adopts a qualitative, discourse-based approach to examine how academic meaning is constructed within AI-supported, multimodal learning environments. The analysis centers on a set of micromodules developed as part of the UOS.DLL project at the University of Osnabrück, which serve as authentic data for exploring the interplay between cognitive processes, multimodal representation, and AI-mediated interaction in academic communication.

3.1. Context and data corpus

Micromodules are short, interactive online learning units (~90 minutes) designed to foster transversal academic competencies such as digital literacy, critical reflection, and self-directed learning. They are freely accessible via the university's learning management system Stud.IP, which also acts as the administrative backend for distribution and integration. All micromodules are licensed under Creative Commons (CC-BY 4.0) and incorporate a range of media formats – text, video, infographics, quizzes, hyperlinks, and AI-generated prompts – creating a multimodal and semiotically rich learning environment.

The present study focuses on two specific micromodules:

- *Welcome to the AI Jungle* (originally in German: *Willkommen im KI-Dschungel*) (University of Osnabrück, 2024c);

- *Expedition AI – How Text-Generating AI Ticks* (originally in German: *Expedition KI – Wie textgenerative KI tickt*) (University of Osnabrück, 2024a).

These were selected because they are the most recent micromodules in the UOS.DLL series and directly address the topic of artificial intelligence while also integrating AI tools into their structure and delivery. Their dual role – both thematically and technologically centered on AI – makes them particularly relevant for examining the evolving nature of academic discourse in AI-supported learning environments. Both modules are designed to promote awareness of AI's role in academic practice, foster responsible tool use, and support reflection on the cognitive and ethical dimensions of digital communication. They include student-facing content, dynamic feedback, and

interactive pathways, making them ideal for analyzing how academic concepts are construed, scaffolded, and sequenced in AI-supported discourse.

Importantly, these micromodules function as more than instructional artifacts; they represent hybrid discourse spaces where meaning is co-constructed through the coordinated input of students, instructors, AI-based tools, and Stud.IP infrastructure. Their modularity, openness, and embedded automation offer a replicable, transparent, and pedagogically structured setting for investigating how academic discourse is evolving in response to technological mediation.

3.2. Methodological approach

The analysis applies concepts and tools from Cognitive Discourse Analysis and Multimodal Content Analysis – both described in Section 2 – to examine how academic concepts are shaped and communicated across textual, visual, and interactive modes. Special attention is paid to metaphorical language, learner feedback, and the design logic of the micromodules, including the role of AI-generated content in shaping reasoning and navigation. This approach supports the investigation of both internal conceptual structuring and external semiotic orchestration in AI-mediated academic discourse.

3.3. Discourse participants and ethical considerations

Discourse in the micromodules unfolds through the interaction of multiple agents:

- *Students* engage with the material, navigate the learning paths, and respond to both fixed and AI-generated prompts.
- *AI based tools*, especially within *Expedition AI* (University of Osnabrück, 2024a), generate tailored feedback based on learner input, modeling academic reasoning processes.
- *Instructors and course designers* curate content, define learning goals, and construct the pedagogical flow of the modules.
- *Stud.IP* administrators manage the platform infrastructure and oversee module integration, usability, and data access protocols.

All data analyzed in this study are publicly available, anonymized, or covered under open licenses (CC-BY 4.0). No personal student information or direct interaction data were accessed. In accordance with General Data Protection Regulation and institutional research ethics, the analysis is limited to non-sensitive, content-based materials and anonymized feedback where relevant.

4. Results and analysis

This section analyzes academic discourse in AI-integrated learning environments through cognitive and multimodal lenses, using examples from two previously introduced micromodules developed at Osnabrück University: *Expedition AI – How Text-Generating AI Ticks and Welcome to the AI Jungle* (University of Osnabrück, 2024a; University of Osnabrück, 2024c).

The analysis is structured around four key dimensions. Section 4.1 examines how learners cognitively construct core academic concepts like learning, argumentation, and autonomy. Section 4.2 explores the multimodal strategies employed in micromodule design to support comprehension and engagement. Section 4.3 discusses how AI functions as a discursive participant in shaping knowledge and interaction. Finally, Section 4.4 brings in learner perspectives to assess how students perceive and evaluate AI-mediated academic discourse. Together, these dimensions offer a comprehensive view of how meaning is co-constructed in digitally enhanced, AI-supported higher education settings.

4.1. Cognitive patterns in concept construction

In this study, we focus on three key concepts – learning, argumentation, and autonomy – as entry points for analyzing the cognitive and discursive dynamics of AI-assisted academic modules. Their centrality is well-documented in the literature on academic literacies (Lea & Street, 1998), cognitive discourse functions (Dalton-Puffer, 2013), and learner agency (Mercer, 2011). These concepts represent foundational dimensions of academic discourse across disciplines and are essential to understanding how learners engage with knowledge in formal education settings. As such, they offer a coherent framework for examining the shifts that occur when academic communication is mediated by AI-driven platforms.

4.1.1. Learning. In academic discourse, learning is frequently represented as a developmental and cumulative process, often framed through metaphors of growth, construction, or movement (e.g., "*building knowledge*", "*progressing through stages*", "*gaining insight*"). These metaphoric structures reflect underlying cognitive schemas that help learners make sense of abstract educational experiences (Lakoff & Johnson, 1980; Sfard, 1998).

In the context of our micromodules, we observe the prevalence of what Lakoff and Johnson (1980) define as the conceptual metaphor LEARNING IS A JOURNEY. This framing is evident not only in educational language (e.g., "*learning path*", "*progress report*") but also in how learners describe their own experience of grappling with knowledge over time. In their reflections, the students describe themselves as "*just starting out*" or "*moving forward*". It is the digital learning architecture – the quiz-based, stepwise progression interface – that reinforces this metaphor. Quizzes serve as checkpoints, videos as on-ramps, and AI prompts as guides nudging students forward or suggesting alternate routes (e.g., "*You might want to revisit the section on AI bias*").

The table below presents selected examples of student feedback that explicitly or implicitly reflects the LEARNING IS A JOURNEY metaphor. These responses, drawn from evaluations of the micromodule *Welcome to the AI-Jungle*, illustrate how learners perceive their engagement with the course as a process involving entry points, progressive stages, detours or delays, and strategic navigation. Each comment is accompanied by its English translation and categorized by the phase of the journey it represents. This metaphorical framing offers insight into the experiential logic underpinning learners' interactions with courseware.

Table 1

Illustrative Student Feedback Reflecting the LEARNING IS A JOURNEY Metaphor*

	German (Original)	English Translation	Cognitive Metaphor Phase
1.	*gute Integration → auch Zeitpunkt (am Anfang) hat sehr gut gepasst*	*Good integration → the timing (at the beginning) worked very well.*	Starting Point
2.	*Sehr gelungen/passend – als Grundlage zu Beginn*	*Very well designed/fitting – as a foundation at the beginning.*	Starting Point
3.	*Durch Videos & Aufgaben → Texte wurden i.d.R. überflogen*	*Through videos and tasks → texts were usually skimmed.*	Progression Through Stages
4.	*Durch die Quizfragen und den Videos → grafische Darstellungen*	*Through the quiz questions and videos → graphic representations.*	Progression Through Stages
5.	*Quiz hat aufgezeigt, was noch vertieft werden sollte.*	*The quiz showed what still needed to be deepened.*	Progression Through Stages
6.	*Texte teilweise zu lang → Texte wurden überflogen → Quiz half das Wichtigste mitzunehmen.*	*Texts were partly too long → texts were skimmed → the quiz helped to grasp the most important points.*	Detours / Repetition
7.	*Texte + Quiz → u.U. etwas viel, wenn am Stück gemacht mit allen Links etc. → Motivation ↓*	*Texts + quiz → possibly a bit too much if done all at once with all the links etc. → motivation dropped.*	Detours / Repetition
8.	*Videos, Zusätzliche Links für vertieftes Wissen*	*Videos, additional links for deeper knowledge.*	Detours / Repetition
9.	*mehr Zeit benötigt als 90 Minuten*	*Took more time than 90 minutes.*	Detours / Repetition
10.	*Abwechslung hat Aufmerksamkeit aufrecht gehalten; Videos haben Texte gut untermauert.*	*Variety kept attention up; videos supported the texts well.*	Wayfinding / Navigation
11.	*Videos und Quizfragen → aber die Texte waren gut.*	*Videos and quiz questions → but the texts were also good.*	Wayfinding / Navigation
12.	*Durch die Aufgaben und das Quiz → Zusammenfassung der Inhalte.*	*Through the tasks and the quiz → summary of the content.*	Wayfinding / Navigation

The metaphor is also spatially and temporally embedded: learners describe movement through content (text, video), adaptation to pace ("2 hours straight doesn't work"), and the need to regulate effort over time. This path-based reasoning supports cognitive coherence and enhances learner orientation in multimodal environments where linearity is not always obvious.

4.1.2. Argumentation as additive refinement. Argumentation has long been central to academic discourse, traditionally involving reasoned debate, engagement with counterclaims, and the testing of ideas (Toulmin, 2003; Andrews, 2009). In the micromodules, however, argumentation appears not through dialogic contestation but through affirmative elaboration – what we term *additive refinement*.

A telling example occurs in *Expedition AI*, where an AI Quiz asks a learner to give a brief definition of *"humanization*" (University of Osnabrück, 2024a). After analyzing the given answer, the AI responds with: *"Thank you for your answer. Let's expand on that,"* before elaborating on ethical, epistemic, and social dimensions. This feedback simulates academic reasoning and models disciplinary depth, but it does so without opposing or critically interrogating the original idea. The result is a form of algorithmic alignment – an epistemic nudge toward complexity, but within a pre-scripted framework (see Jones et al., 2022).

The language used by the AI is strikingly personified: phrases like *"Let's expand on that"* or *"I appreciate your input"* frame the AI as a conversational partner (cf. Nass & Moon, 2000). Visually, the interface mimics a dialogue: student input and AI feedback appear in paired blocks, echoing chat interactions and reinforcing the illusion of human-like exchange. Through this stylization, the AI adopts a rhetorical identity – not merely delivering information, but performing a tutoring persona.

However, this persona also introduces a subtle constraint. Learners are encouraged to elaborate, not to disagree. By affirming and extending rather than challenging input, the AI narrows the range of acceptable discursive moves, potentially undermining criticality. This reflects a broader shift in argumentation pedagogy toward low-risk elaboration over confrontational reasoning, especially in scaffolded digital settings (Mercer, 2011; Zawacki-Richter et al., 2019).

Student reflections mirror this pattern: learners describe how the course *"expanded my understanding"* or *"helped me look at the topic from a different perspective,"* but rarely report instances of argument construction through opposition or critique.

4.1.3. Autonomy as bounded agency. Autonomy – broadly associated with learner control, choice, and metacognitive awareness (Little, 1991) – is a central goal in digitally mediated education. In the micromodules, autonomy is structurally supported: learners can skip content, revisit sections, or navigate at their own pace. However, this freedom is bounded by choice architecture: subtle nudges and layout cues (or *prompts*, in the sense of Thaler & Sunstein, 2008) that guide learner behavior without explicitly directing it.

Prompts like *"You might want to review this topic before continuing"* signal suggested routes rather than open exploration. You might want to review this topic before continuing" signal suggested routes rather than open exploration. This aligns with Evans' (2007) concept of bounded agency, where learners navigate within structured yet adaptable environments that foster guided independence rather than complete autonomy.

In *Welcome to the AI Jungle*, this guidance becomes more embodied. The use of AI-generated voice overs and avatars via tools like *HeyGen* introduces a literal AI "presence". This digital persona doesn't just deliver content – it speaks with intonation, emotion, and consistency. The result is a semi-anthropomorphic AI figure that performs instruction; reinforcing trust and emotional engagement through affective semiotics (see Sundar & Kim, 2019). While this increases immersion and accessibility, it may also reduce critical distance, leading learners to internalize rather than interrogate the content.

Still, the micromodules preserve elements of learner agency: users can choose entry points, opt out of AI feedback, or navigate non-linearly. This interaction reflects negotiated autonomy, where learners must balance personal initiative with the persuasive logic of interface design and algorithmic feedback.

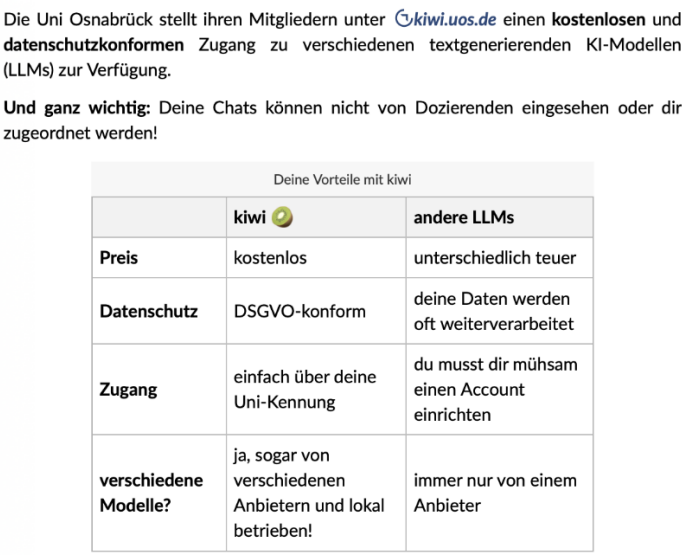
In summary, AI in these learning environments functions as both semiotic and pedagogical actor. It shapes how learners move, think, and choose – often through subtle cues that simulate human interaction while operationalizing instructional intent. Understanding AI as a discursive participant reveals the urgent need for critical digital literacy: not only to navigate academic content, but to interrogate the systems through which that content is increasingly produced and personalized.

4.2. Multimodal strategies in meaning-making

The micromodules developed at the University of Osnabrück demonstrate a highly intentional use of multimodal design strategies to facilitate academic meaning-making in AI-supported learning environments. These strategies align with the foundational principles of multimodal discourse theory, which views meaning as constructed not through language alone but through the orchestration of multiple semiotic modes – visual, spatial, textual, and interactive (Kress & van Leeuwen, 2006). Within these micromodules, such modes are not ancillary but central to the communicative architecture of the learning experience.

One prominent example is the spatial modularity of content. Micromodules are organized into sequenced courseware blocks – including text, learning cards, hyperlinks, videos, and quizzes. This structure supports what Kress (2010) terms "reader-designed pathways", allowing learners to navigate material in ways that suit their prior knowledge and learning goals. Visual formatting, such as bolded headings, colored icons, or navigational tabs, provides a clear "red thread" through the content, reducing cognitive load while supporting continuity and learner orientation (Piwowar & Dovhaniuk, 2025).

Figure 1 below illustrates the screenshot from the micromodule *Expedition AI* (University of Osnabrück, 2024a) introducing the advantages of the *kiwi* platform, which provides access to large language models through the Osnbrück university's infrastructure. This introductory paragraph supports multimodal learning by combining visual elements (icons and tables), spatial structuring (comparison columns), and microcopy (tooltips and privacy notes) to scaffold learner understanding of system functionalities. The presentation of information is not merely factual – it is designed to build trust, encourage exploration, and frame user agency.



Die Uni Osnabrück stellt ihren Mitgliedern unter kiwi.uos.de einen **kostenlosen** und **datenschutzkonformen** Zugang zu verschiedenen textgenerierenden KI-Modellen (LLMs) zur Verfügung.

Und ganz wichtig: Deine Chats können nicht von Dozierenden eingesehen oder dir zugeordnet werden!

Deine Vorteile mit kiwi

	kiwi	andere LLMs
Preis	kostenlos	unterschiedlich teuer
Datenschutz	DSGVO-konform	deine Daten werden oft weiterverarbeitet
Zugang	einfach über deine Uni-Kennung	du musst dir mühsam einen Account einrichten
verschiedene Modelle?	ja, sogar von verschiedenen Anbietern und lokal betrieben!	immer nur von einem Anbieter

Figure 1. Screenshot of the page in the micromodule *Expedition AI* introducing the *kiwi* platform (University of Osnabrück, 2024a).

Within the micromodules themselves, visual media play a dual role: both as cognitive scaffolds (e.g., infographics that clarify abstract concepts) and as affective cues that sustain learner engagement across asynchronous, self-paced units. Decorative or thematic visuals – such as AI-generated illustrations – signal content transitions and make otherwise dense topics feel accessible and relevant (Piwowar & Dovhaniuk, 2025).

Interactive elements reinforce this design. For example, pre-quizzes in *Expedition AI* (University of Osnabrück, 2024a) do not merely test factual recall but encourage reflection and self-assessment through adaptive feedback mechanisms.

One of the most salient features is the strategic deployment of visual elements such as infographics, images, and tables. These serve to clarify abstract concepts, organize information spatially, and reduce cognitive load, thereby supporting learner comprehension.

In addition to these pedagogically functional visuals, AI-generated decorative imagery is occasionally used to maintain attention and signal thematic shifts, contributing to a more dynamic and engaging learning environment (Piwowar & Dovhaniuk, 2025). This design reflects the broader goal of supporting sustained learner engagement, particularly in asynchronous self-study settings.

Importantly, the design also incorporates interactional features that emulate dialogic patterns common in human-led educational settings. Although learners do not interact with a human instructor in real time, the system offers responsive elements such as adaptive feedback prompts (Figure 2), embedded suggestions for reflection or further action (e.g. Always verify the accuracy of the generated texts, as AI-generated content may contain hallucinations), elaborative quiz responses, etc. These features simulate conversational feedback and scaffold deeper processing, which is essential for conceptual transfer and learner autonomy (Zawacki-Richter, Marín, & Bond, 2019).

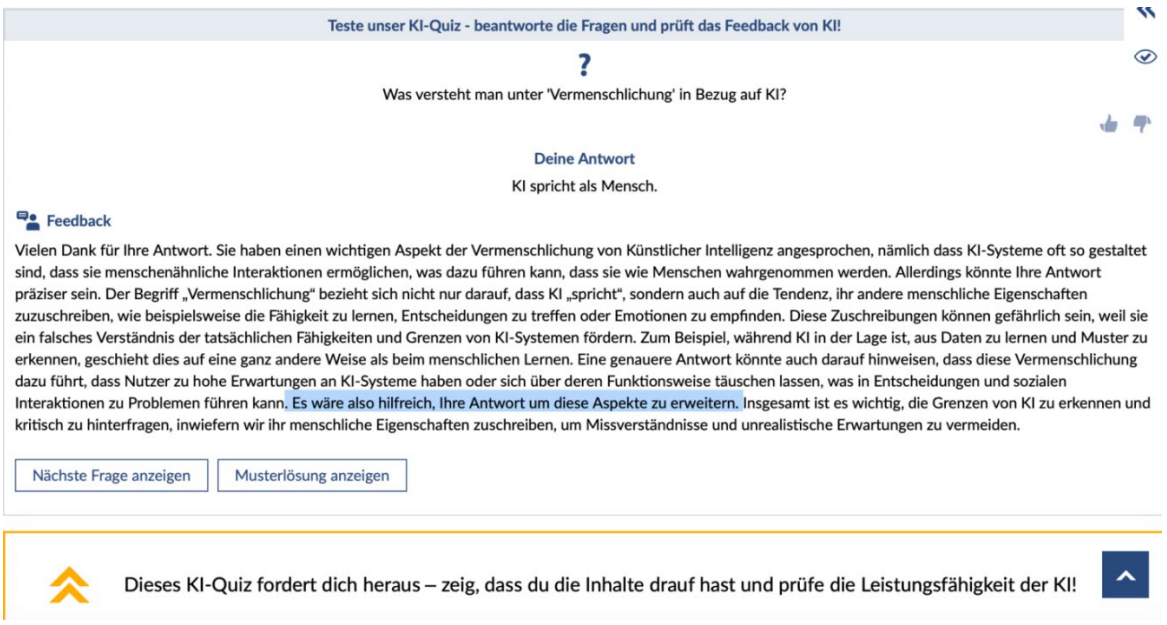


Figure 2. Screenshot from the micromodule *Expedition AI* - Showing the AI pointing out options to a student, i. e. returning to specific aspects within the completed unit again that emphasize the given answer even more.

The tone of instructional language in the MiMos also reflects deliberate stylistic choices that balance formality with accessibility. The presentation emphasizes the importance of tonal calibration – alternating between serious and humorous, formal and informal registers – to maintain learner engagement without sacrificing academic credibility (Figure 3). This aligns with recent shifts in digital pedagogy that advocate for more personalized and emotionally resonant communication, especially in modular, AI-supported environments.

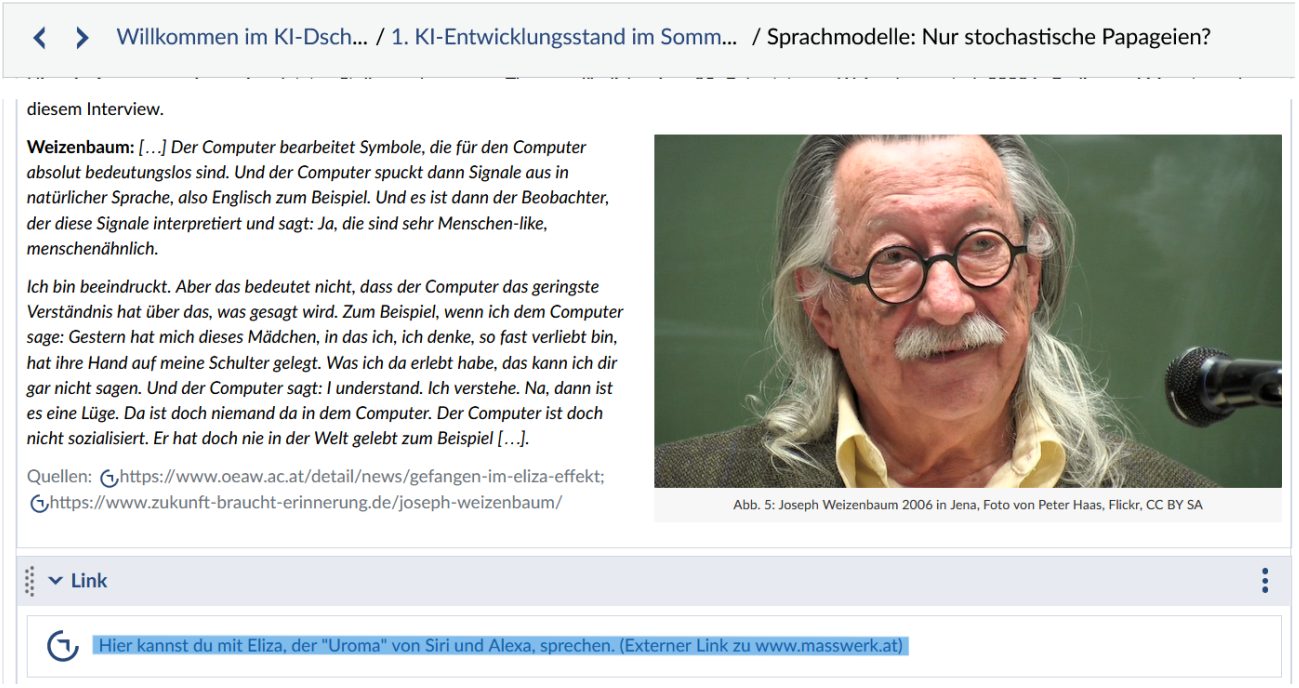


Figure 3. Screenshot from the micromodule *Welcome to the AI Jungle* – Focusing the call to action below: Here you can speak with Eliza, the "great-grandmother" of Siri and Alexa (external link to www.masswerk.at)

Overall, the multimodal strategies observed in the micromodules are not merely enhancements but integral components of academic discourse construction. They shape how learners interact with content, manage their cognitive load, and internalize complex ideas. By combining linguistic clarity with visual structure and interactive responsiveness, micromodules offer a compelling example of how multimodal design can support both comprehension and critical engagement in digitally mediated higher education.

4.3. AI as a discourse participant

In the micromodules, AI is not a passive delivery mechanism but an active participant in the construction of academic discourse. In the micromodule *Expedition AI – How text-generative AI ticks* (University of Osnabrück, 2024a), an AI quiz generator is presented with its main functionalities – such as automated feedback and adaptive content generation – which demonstrates the growing discursive presence of algorithmic systems in shaping how academic knowledge is framed, scaffolded, and evaluated.

For example, a student selecting an incorrect answer might receive a tailored explanation or an invitation to revisit a prior content block (Figure 4). This pattern mirrors formative feedback loops traditionally provided by instructors and is instrumental in guiding the learner through self-regulated learning pathways (Zawacki-Richter et al., 2019).

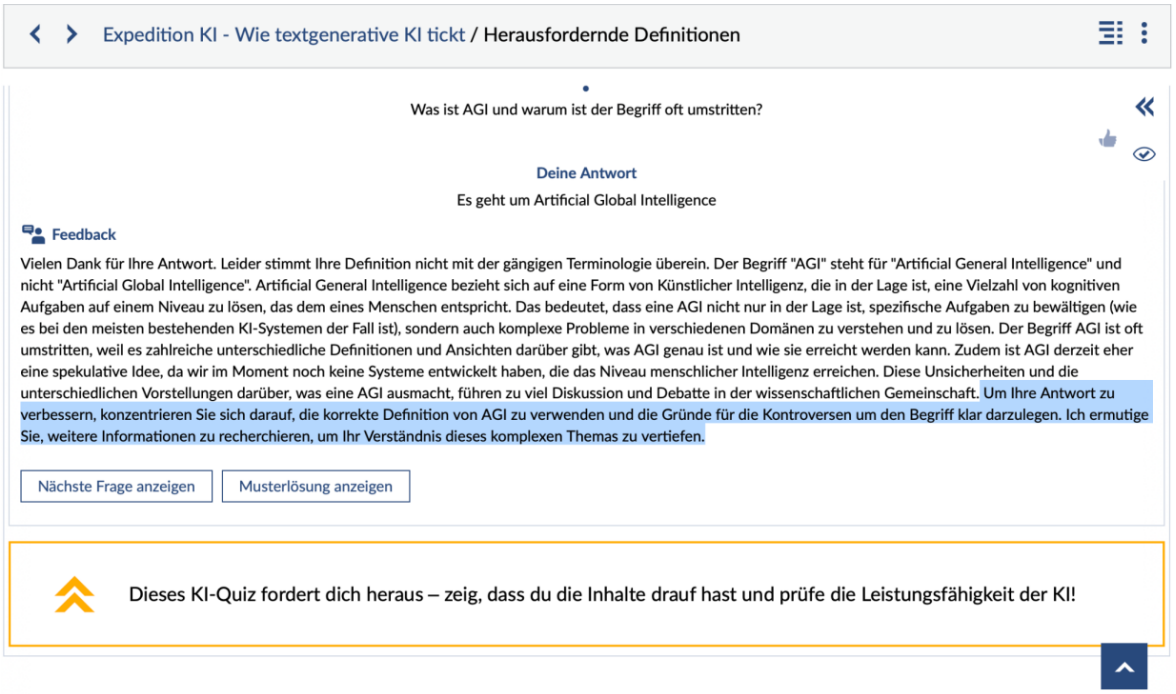


Figure 4. Screenshot from the micromodule *Expedition AI* with learner's response and AI generated feedback.

The micromodule *Welcome to the AI Jungle* (University of Osnabrück, 2024c) experiments with AI tools like *HeyGen* for content creation. Such a tool was employed to function as a co-authoring agent as well as to keep learners engaged.

From a discourse perspective, this form of AI integration reconfigures the traditional roles of teacher and text, placing learners in a hybrid interactional space where content is delivered not solely by a human instructor but by a semi-autonomous system. This shift raises important pedagogical questions: when learners accept AI prompts or explanations without interrogation, student autonomy and metacognitive agency can be inadvertently limited. Recent research by Kosmyna et al. (2024) shows that students who used ChatGPT to support essay writing exhibited lower brain connectivity, reduced ownership, and less cognitive engagement compared to those who completed the task without AI support. These findings suggest that, while AI tools can increase efficiency, they may also lead to passivity and a decline in metacognitive activity, raising important questions about how LLMs reshape academic learning.

At the same time, the modules offer interactive affordances that allow learners to skip, return, or remix content – preserving a degree of agency. For instance, the integration of self-paced navigation, editable OER content, and "call to action" elements not tied to every content page gives students flexibility in how deeply they engage with AI-scaffolded materials.

In summary, the micromodules reflect an emerging model of AI as a semiotic and pedagogical agent. By participating in meaning-making through feedback, content formulation, and tone modulation, AI systems begin to occupy an authorial space traditionally reserved for educators. This development underscores the importance of critical digital literacy – both for students who must learn to navigate AI-generated discourse critically, and for educators designing with these tools in mind.

4.4. Learner perspectives on AI-supported academic discourse

The integration of student feedback provides a valuable perspective on how learners perceive, interpret, and emotionally respond to AI-mediated academic discourse. Responses collected from 27 students across two seminar groups following the use of the micromodule *Willkommen im KI-Dschungel* (University of Osnabrück, 2024c) reveal important themes related to learning strategies,

cognitive engagement, multimodal preferences, and the perceived affordances and limitations of AI in higher education.

Many students reported that they learned most effectively through a combination of videos, quizzes, and infographics, noting that this multimodal format supported comprehension and retention. Several explicitly mentioned using the quiz to "revisit the text", suggesting a recursive learning pattern and aligning with cognitive models of self-regulated learning (Hadwin et al., 2018). One student noted: "*Learned well through the quiz – texts were long and in-depth – the quiz made me look at the text again*," highlighting the quiz as a cognitive trigger rather than a mere assessment tool.

Student reflections also demonstrate how autonomy is framed as navigational choice within courseware. While some praised the self-paced flexibility, others described the structure as "*too much if done all at once*," indicating a tension between perceived control and cognitive overload.

Student awareness of AI's limitations was evident. Several respondents reflected critically on the epistemic authority of AI-generated content. For instance, one student cautioned that AI-generated materials should not be "*blindly trusted or passed on to students*." Another highlighted the need for transparent sourcing of information, suggesting a metacognitive awareness of how knowledge is constructed within AI systems: "*One has to reflect – where does the information come from?*"

This reflects a shift from argumentation as acceptance to argumentation as verification, positioning students as co-constructors of knowledge who engage with AI feedback not passively but evaluatively. The value of AI in prompting such reflection is reinforced by comments like "*Can AI stimulate thinking*?" which frames the machine as a provocateur of academic reasoning.

Feedback on multimodal design was particularly revealing. The use of videos was polarizing – some found them "motivating" and helpful for complex topics, while others considered them "exhausting" or preferred textual formats. One student summarized: "*Texts were long and deep – video helped support the text when complex,*" indicating a preference for strategic multimedia pairing rather than constant audiovisual input.

Visual tools such as infographics and icons were widely praised for aiding navigation and summarization. Multiple students commented that the course structure and visual layout were sometimes overwhelming, with issues such as unclear interface, navigation challenges on laptops, and difficulty tracking progress. These issues highlight the need for a clearer alignment between interaction design and cognitive load.

Several noted the potential of integrating AI into lesson preparation and student motivation but emphasized the need for critical framing. For example: "*AI is here to stay – enables innovative teaching – topic: motivation!*" However, concerns were also raised about data protection, student readiness, and context-specific use: "*Not everything is GDPR-compliant: can/may not be used in school with students*."

These student voices affirm the discursive and cognitive findings of Sections 4.1 – 4.3 while offering important user-centered insights. They suggest that for AI-supported discourse to be effective, it must balance guidance and autonomy, personalize content without overwhelming, and invite reflection without over-structuring responses. The pedagogical design must account not only for what learners are meant to achieve but how they feel and position themselves in relation to AI as a knowledge partner.

5. Discussion

The findings of this study foreground the emergence of academic discourse as a multimodal, cognitive, and increasingly hybrid process shaped by both human and AI actors. The micromodules from the University of Osnabrück illustrate a paradigmatic shift from static, monologic discourse to a form of interactive reasoning that blends narrative scaffolding, visual logic, and machine feedback.

Cognitively, students' experiences reflect an internalization of metaphoric frames such as LEARNING IS A JOURNEY, reinforced not only linguistically but structurally through sequential

quiz prompts, AI-generated suggestions, and path-based navigation. These interactions illuminate how digital tools co-construct meaning with users, transforming cognitive metaphors into interface logic. Learners don't merely move through content—they traverse cognitively framed terrains, guided by semiotic and algorithmic cues.

The multimodal design of the micromodules plays a decisive role in shaping academic understanding. Visual elements like infographics and AI-generated illustrations, along with adaptive text and feedback layers, actively support comprehension and emotional engagement. Student feedback underscores this value but also signals a threshold: multimodality, if overused or misaligned, can overwhelm rather than assist, highlighting the need for intentional design attuned to cognitive load.

AI emerges not just as a tool but as a participant in academic discourse. It performs functions traditionally associated with instructors – such as feedback, explanation, and prompting – while also shaping the tone and rhythm of academic interaction. Students describe AI feedback as insightful and even "human-like," suggesting a reconfiguration of epistemic authority. Yet they also express skepticism, questioning the reliability and source transparency of AI-generated content. This ambivalence signals the development of epistemic vigilance – a critical competence in the age of AI-mediated knowledge.

These developments challenge established models of academic literacy. In contrast to traditional pedagogies emphasizing solitary authorship and linear argumentation, the AI-supported environment promotes collaborative, iterative meaning-making within a bounded yet flexible architecture. Learner autonomy is exercised within guided pathways; argumentation is framed more often as elaboration than confrontation. The implication is not a wholesale replacement of traditional discourse but an evolution toward more fluid, dialogic, and multimodally encoded academic practices.

These findings resonate with prior work in both cross-cultural metaphor research (Shevchenko & Shastalo, 2021) and multimodal discourse analysis in affective film contexts (Krysanova & Shevchenko, 2021), highlighting the cognitive flexibility of meaning-making across domains and modalities. They also align with the objectives of the Erasmus+ DigiFLEd project, which supports the integration of AI tools and multimodal course design in foreign language teacher education across Ukrainian institutions. Like the Osnabrück case, DigiFLEd promotes modular, learner-centered learning environments, embedding digital literacy and reflective pedagogy into scalable training formats. Together, these initiatives point to a shared imperative to reimagine academic discourse as a collaborative endeavor between human and algorithmic agents.

To navigate this new terrain, both learners and educators must cultivate not only digital proficiency but critical digital literacy – the ability to interpret, question, and strategically engage with AI-mediated discourse. This calls for pedagogical approaches that foreground transparency, agency, and reflexivity in the design and use of AI tools in higher education.

6. Conclusion

This article has examined how AI-supported, multimodal environments reshape academic discourse in higher education, using micromodules from the University of Osnabrück as a case study. Through a combined cognitive and multimodal discourse analysis, the study has shown how learners construct meaning at the intersection of human cognition, digital design, and AI-generated input.

The metaphor of LEARNING AS A JOURNEY emerged as a central cognitive schema, embodied in both interface design and student reflection. Multimodal strategies – including visual scaffolds, dialogic feedback, and tonal modulation – were found to be essential not only for comprehension but for sustaining engagement and signaling authority. At the same time, the presence of AI as a discursive co-participant raises critical questions about agency, authorship, and trust.

Student perspectives affirmed the potential of these environments for personalization and engagement but also revealed concerns about overload, interface usability, and epistemic reliability. These tensions underscore the need for pedagogical frameworks that integrate critical digital literacy with instructional innovation.

In conclusion, academic discourse in the age of AI is no longer a purely human endeavor. It is co-authored, multimodally expressed, and algorithmically scaffolded. ***The challenge ahead*** is to ensure that such environments support – not substitute – critical thinking, reflexive learning, and equitable participation in academic knowledge-making. As educators, researchers, and designers, we must engage with AI not just as a tool, but as a transformative presence in the evolving ecology of higher education.

Declaration of competing interest

No potential conflict of interest was reported by the authors.

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МУЛЬТИМОДАЛЬНІ ТА КОГНІТИВНІ ПІДХОДИ ДО АКАДЕМІЧНОГО ДИСКУРСУ В НАВЧАННІ З ШІ-ПІДТРИМКОЮ

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Анотація
У статті розглядається, як академічний дискурс трансформується у вищій освіті під впливом інтеграції штучного інтелекту (ШІ) та мультимодального дизайну, що розуміється тут у межах мультимодальної теорії дискурсу (а не в сенсі мультимодальних ШІ-моделей). Спираючись на когнітивну лінгвістику, соціокогнітивну теорію дискурсу та мультимодальну семіотику, дослідження аналізує як академічні поняття структуруються та передаються у навчальному середовищі, збагаченому ШІ. Об'єктом емпіричного аналізу є два мікромодулі, розроблені в Оснабрюкському університеті – *Welcome to the AI Jungle* і *Expedition AI*, які поєднують текст, візуальні елементи, інтерактивність та зворотний зв'язок від ШІ на платформі управління навчанням Stud.IP (LMS). Методологічно дослідження поєднує когнітивний аналіз дискурсу з аналізом мультимодального контенту, зосереджуючись на тому, як студенти опрацьовують поняття *навчання*, *аргументації* та *автономії* в умовах взаємодії з алгоритмічними агентами.

Результати показують, що студенти орієнтуються у контенті через концептуальні метафори на зразок НАВЧАННЯ – ЦЕ ПОДОРОЖ, які підкріплюються структурою модулів та механізмами зворотного зв'язку. Аргументація реалізується у вигляді поетапного розгортання думки без полеміки, тоді як автономія формується у межах інтерфейсної навігації. ШІ постає як семіотичний учасник академічного дискурсу, впливаючи на побудову значення через тональність, візуальні образи та стилізацію діалогу. Ці патерни вказують на зміщення у бік гібридного, діалогічного академічного спілкування, де агентність розподілена між людьми та алгоритмами. У статті стверджується, що в умовах мультимодального навчання з використанням ШІ академічну грамотність слід переосмислювати як результат співпраці між студентами, викладачами та цифровими інструментами. Також наголошується, що розвиток критичної цифрової грамотності є ключовим для створення навчальних програм, орієнтованих на виклики майбутнього.

Ключові слова: *автономія, академічний дискурс*, *мікромодуль*, *мультимодальність, пізнання*, *штучний інтелект, цифрова грамотність*.

Декларація про конфлікт інтересів
Автори на мають жодних конфліктів інтересів щодо цієї статті.