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Fostering an effective learning outcome in an expert-led lecturing series

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ABSTRACT

Practice-oriented lecture series featuring industry experts intend to bridge theoretical knowledge and professional practice. Yet their pedagogical potential tends to remain unrealized: without coherent structure and constructive alignment, such series resemble loosely coupled conference presentations that impede rather than foster learning.
To address these challenges, we developed a systematic framework comprising interrelated measures spanning curricular design, lecturer and subject matter curation, structural coherence, constructive alignment, examination design, and student expectation management. The framework translates the ARIVA framework and constructive alignment into concrete, lecture-specific action items that industry experts can execute with limited pedagogical training, while preserving diversity in teaching styles and disciplinary perspectives.
Applied to the lecture series Trends in Risk and Safety at the Technical University of Munich and evaluated across two consecutive terms, the framework yielded measurable improvements: ARIVA structuring, constructive alignment, and alignment to the learning objectives of the module improves measurably. The quality of the final exam improved in the dimensions reliability, validity, fairness, and consistency. We identify persistent challenges, particularly in reflective problem design and higher-taxonomy assessment formulation, and propose targeted interventions. The approach and its operative artifacts are transferable to both novel and established lecture series in engineering and professional education.

KEYWORDS

Practice-oriented lecture series;
Constructive alignment;
ARIVA framework;
Competence-oriented teaching;
Multi-lecturer formats;
Industry-expert lecturers

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Introduction

Competence-oriented teaching and learning facilitate the development of integrated knowledge, skills, and attitudes that enable learners to act autonomously and effectively in complex and novel situations (Weinert, 2001), emphasizing the transferability of learning, self-regulation, and reflective judgment

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in stark contrast to content reproduction. The ARIVA framework (Arrive/Activate, Reactivate, Inform, Process, Evaluate) structures instructional sequences aligned with these competence-based goals (Städeli et al., 2010). In the Arrive phase, the learning environment is prepared to establish cognitive and motivational readiness. Then, prior knowledge is reactivated to create coherent links to new content, fostering integration. During informing, new knowledge is acquired in alignment with targeted competencies (Anderson & Krathwohl, 2001). In the process phase, learners actively engage and reflect practically to integrate knowledge, ultimately supporting the development of deep understanding and competence. Finally, evaluation encompasses both assessment and reflection to consolidate learning and ensure its transferability to novel contexts. Through this coherent five-phase sequence, ARIVA operationalizes competence-oriented pedagogy by systematically connecting intentional instructional design with learner-centered knowledge construction (Städeli et al., 2010).

Implementing such competence-oriented frameworks in university teaching poses distinct challenges depending on the instructional format. Frontal teaching by means of lecturing remains the most traditional way of university instruction, as a single subject-matter expert efficiently conveys a large volume of information to a broad audience. Students value the structure and peer networks that regular live lectures foster (Loughlin & Lindberg-Sand, 2023). Yet, the format of frontal lectures has been criticized for its limited opportunities for in-class participation and its neglect of individual learning needs. Thereby, higher-level knowledge acquisition and critical thinking are not motivated (Deslauriers et al., 2019; Loughlin & Lindberg-Sand, 2023). Moreover, when lectures are loosely coupled to learning outcomes, practices, and assessments, i.e., when constructive alignment is absent, the learning outcome may not be effective.

Constructive alignment, a foundational concept in higher education pedagogy, comprises three interconnected areas: the intended learning outcomes, which describe what students can achieve upon completing the module; the assessments, which evaluate whether students have achieved these outcomes; and the teaching and learning activities, which create a learning environment enabling students to develop the intended competencies (Biggs, 1996).

Practice-oriented lecture series offer a complementary model: a sequence of talks on a common theme, delivered by alternating experts from industry and different disciplines, to explore the theme transdisciplinarily (Gerstein, 1995). Such lecture series, especially those featuring high-profile speakers, can significantly broaden the discourse, provide professional context, and help students bridge theoretical coursework with real-world problem-solving and research practice (Kaman et al., 2022; Turner et al., 2011; Rüde et al., 2018). When well-designed and well-embedded into the curriculum, lecture series can promote higher-level knowledge acquisition, awareness of already acquired skills, recognition of one's work's contribution in a broader context, and consequently enhanced motivation for involvement (Surovek & Karlin, 2006; McNab et al., 2019). Industry–university collaboration around such series also aligns with outcome-based education and better prepares students for professional practice (Akran et al., 2015).

However, practice-oriented lecture series present unique pedagogical challenges that can undermine their educational potential. Such series can resemble conference sessions: variability in style and rigor across invited speakers may compromise coherence; some talks tend to focus on advertising particular methods or project outcomes rather than cultivating conceptual understanding. The lack of alignment between individual lectures can confuse students about what to learn, causing them to revert to superficial information recitation (Loughlin & Lindberg-Sand, 2023). Students who are confronted with incoherent lecture material struggle to extract examinable knowledge (Deslauriers et al., 2019; Loughlin & Lindberg-Sand, 2023). While Gerstein (1995) suggests choosing speakers based on their expertise and performance ability, Deslauriers et al. (2019) find that superstar lecturers — experts with professional-like speaking skills — may falsely foster the impression among students of overly effective learning outcomes without genuine understanding. Hence, speakers should be curated based

on multiple criteria to promote effective learning outcomes. The success of students in active learning depends significantly on their engagement and motivation (Deslauriers et al., 2019), indicating that subject experts who create positive learning environments through teaching expertise, interpersonal skills, and accessibility may be key to fostering effective learning outcomes even in high-profile lecture series.

Establishing a shared conceptual structure and clear guidance can mitigate incoherence across lectures while preserving diversity in teaching styles, personalities, and industry perspectives. Such guidance defines common learning objectives, thematic links, and expectations for depth and scope, enabling lecturers to align their content without sacrificing individuality (Biggs, 1996; Anderson & Krathwohl, 2001). Thereby, constructive alignment is supported, fragmentation is reduced, and students are better able to integrate knowledge from individual lectures to achieve higher-level understanding (Anderson & Krathwohl, 2001) more effectively (Deslauriers et al., 2019; Loughlin & Lindberg-Sand, 2023).

The lecture series examined in this work exemplifies the described challenges. The objective of this work is to enhance student learning outcomes by transforming a practice-oriented lecture series from a loosely coupled set of expert presentations into a coherent, outcome-oriented learning environment. To this end, we make the following contributions:

- Existing literature on practice-oriented lecture series addresses speaker selection and thematic curation (Gerstein, 1995) but does not provide a systematic framework for establishing pedagogical coherence across heterogeneous industry presentations. We address this gap.
- Competence-oriented frameworks such as ARIVA (Städeli et al., 2010) and constructive alignment (Biggs, 1996) are well-established for single-lecturer courses. We operationalize these principles for a multi-lecturer, alternating-expert format where individual lecturers lack pedagogical training.
- Lecturer selection in lecture series has been based on expertise and presentation ability (Gerstein, 1995). We extend curation to four operationalized teaching competence dimensions — preparation, clarity, social interaction, and monitoring — serving as evaluative criteria for formative feedback and, as a last resort, summative decisions.
- Lecture series typically state design intentions without systematic assessment. We provide a practical multi-dimensional rating mechanism and a coupled catalog of measures, and demonstrate their effectiveness through a pre-post comparison across two terms including quantitative examination analysis.
- Beyond the conceptual framework, we deliver operative artifacts, enabling direct application to other practice-oriented lecture series without requiring pedagogical expertise from lecturers. The artifacts comprise rating criteria, individualized action item templates, and onboarding protocols.

This work is structured as follows: Section 2 frames the context and analyzes the first version of the lecture series. In Section 3, the set of measures taken to foster effective learning outcomes is detailed. Their implementation is detailed in Appendix A and expanded to full detail, as discussed with each lecturer in Appendix D. In Section 4 the revised lecture series is assessed. We conclude this work with a discussion of the pre-post comparison in Section 5 and thereby propose measures for continuous improvement.

2. Context and Problem Statement

2.1 Embedding practice-oriented learning into the Master's Program Risk and Safety

The engineering Master's program Master of Science in Risk and Safety, at the Technical University of Munich, was launched in the Winter term 2023/2024, see (Straub D., Teichgräber M. 2022). It aims to bring forth experts who are capable of addressing the safety and risk concerns of socio-technical systems, which are increasingly complex nowadays. A key focus is on educating individuals to adopt a holistic view of risks within organizations, fostering a strong safety culture, and promoting effective decision-making. Communication of risks and understanding risk perception are also cornerstone learning contents of the program, required in practice. Ultimately, graduates are trained to be professionals, ensuring safety and reliability in management, development, production, and operations in various industries. The interdisciplinary focus of the program uniquely qualifies graduates to bridge technical risk assessment with organizational and societal perspectives, meeting a growing demand in sectors such as industry, certification bodies, consulting, and public authorities, see (Straub D., Teichgräber M. 2022).

Within the program, the compulsory module cluster Risk in Practice aims to transfer the theoretical knowledge acquired by the students to practical applications. The cluster has 15 credits of a total of 120 credits in the program. Project work, of current scientific and industrial contexts, enable active student participation. In the lecture series Trends in Risk and Safety, different experts acting as guest lecturers present current industry-specific topics. While the content of the lecture series is delivered by industry experts, the lecture series is managed by an academic lecturer. Thereby, students may gain a broader understanding of the risk and safety domain across various domains, while the alignment to the curriculum is ensured. The lecture module is weighted with three credits, while the project work, denoted as Risk Lab, is weighted with twelve credits

2.2 The Lecture Series Trends in Risk and Safety

When introduced in winter term 2023/2024, the module content had been described as (TUM 2023): "*The module gives a small insight into different areas of practice. Experts from industry, authorities, and research institutions deliver lectures on topics related to their areas of expertise in risk and safety, and discuss the challenges in their fields with students. The module has only 3 credits because it only gives a small insight into different areas of practice*." It is stated that no prior knowledge is expected. The learning objectives had been phrased as: "*Upon completion of the module, students will be able to comprehend applications of risk and safety assessment from current practice and research. The students can thus link their theoretical knowledge gained from other modules to practical experience*." The teaching and learning method had been described as: "*Knowledge transfer by means of presentations by alternating lecturers and discussion.*"

This description is reflected in light of its potential to adversely impact the students' learning outcomes. Thereby, we find that the phrase "*small insight*" is vague and may diminish the perceived value of the module. This is underlined by stating that the module has "*only 3 credits*"[2]. The types of challenges remain unspecified. Not expecting any prior knowledge gives the false impression of the module as an introductory course. The first learning objective fits the second level of Bloom's taxonomy (Anderson & Krathwohl, 2001), i.e., to understand. Accordingly, students should be able to explain and comprehend ideas and concepts based on prior learning. The learning objective is, however, unspecific. The second learning objective raises the expectation that theoretical knowledge is employed practically, such as by solving cases from industry. The teaching and learning method does not detail

[2] Within the cluster of compulsory modules, the module Trends in Risk and Safety has three credits, while three modules are weighted with five credits, one with seven credits, and one with twelve credits. Further modules weighted with three credits may be selected from the list of elective modules, ranging from three to six credits.

the instructional design or media usage. Also, active learning or student engagement may not be foreseen, i.e., discussions are mentioned, yet, these may be discussions between experts.

The original curation of lecturers and subject matters

A set of speakers had been curated on the principle of providing a holistic view on the theme of the lecture module. Thereby, the individual lecturers had been chosen based on:

- Industry background, i.e., to provide a broad range of industries
- Field of work, i.e., to provide a holistic view from an e.g. management, development, legal, regulatory, operations perspective
- Expert level / Seniority

Neither subject matters had been reviewed for alignment with shared learning outcomes, nor had thematic coherence across the series been considered at first as a curation criterion. Hence, the overlap in application domain, i.e. out of nine lectures, three were based on perspectives in autonomous mobility and two from Civil Engineering, and work focus, i.e. out of nine lectures two focused on functional safety and two focused on risk-informed civil engineering and lecture three had a significant overlap to these as well.

Tables 1 and *2* list the lecturers of Winter Terms 2023/2024 and 2024/2025. The names have been anonymized. The lecturers of Winter Term 2023/2024 that had become unavailable had been replaced for Winter Term 2024/2025. MaTr, the lecturer of Lecture 3, is a manager who motivated one of his senior experts to present. However, the expert had become unavailable on short notice and MaTr stepped in to keep the commitment to the lecture series.

Table 1: Characteristics of the lecturers for Winter Term 2023/2024.

Lecturer	Lecture	Industry	Field of Work	Level of expertise*
InKr	L1	Civil Engineering	Project Management in large infrastructure projects	Senior
UlNi	L2	Medical	Clinical Reviewer for Medical Devices	Senior
BjMa	L3	Emergency Response	Fire Risk Mitigation	Senior
ThWi	L4	Autonomous Mobility (Automotive)	Functional Safety for ADAS	Senior
HaSw	L5	Aerospace	Configuration Management	Senior
VoHa	L6	Autonomous Mobility (Intralogistics)	Legal counsel for product compliance and liability	Senior

MaRo	L7	Autonomous Mobility (Rail)	Functional Safety	Senior
MaSc	L8	Civil Engineering	Risk-informed engineering in infrastructure projects	Senior
AnLa	L9	Insurance	Environmental Risks Modelling	Intermediate

* Technical expertise is categorized into three tiers: Junior (typically ≤ 2 years), Intermediate (approximately 3–7 years), and Senior (≥ 8 years).

Table 2: Characteristics of the lecturers for Winter Term 2024/2025.

Lecturer	**Lecture**	**Industry**	**Field of Work**	**Level of expertise***
UlNi	L1	Medical	Clinical Reviewer for Medical Devices	Senior
LuDr	L2	Automotive	Probabilistic Safety Modelling & Simulation	Intermediate
MoWe				Senior
MaTr	L3	Automotive	Passive Safety Testing Manager	Manager
RiMu	L4	Aerospace	Safety Management	Senior
LuBe				Intermediate
AnLa	L5	Insurance	Environmental Risks Modelling	Intermediate
ReiRo	L6	Automotive	Human Factors Engineering	Senior
BjMa	L7	Emergency Response	Fire Risk Mitigation	Senior
MaSc	L8	Civil Engineering	Risk-informed engineering	Senior
MaRo	L9	Mobility	Functional Safety	Senior
RaSa	L10	Insurance	Qualitative Risk Modelling	Senior

The original lecture style

Conference presentations are primarily designed to convey novel findings compactly to peers; learning or competence development is not the focus. Industry experts, who are socialized as conference presenters rather than academic teachers, tend to reproduce the same format rather than didactically structured lessons (Loughlin & Lindberg-Sand, 2023; Gerstein, 1995). During the winter terms 2023/2024 and 2024/2025, the majority of lecturers had designed their presentations in the style of conference presentations, derived from (a composite of) conference presentations or reused without adaptation. Hence, the focus of the lectures had been on informing about a method or showcasing the story and outcomes of recent projects.

When analyzed against the ARIVA framework (see Section 1), these lectures exhibited systematic gaps: the arrive and reactivate phases had largely been absent, the inform phase dominated, and the process and evaluate phases had rarely been implemented, leaving students without structured opportunities for consolidation or reflection.

Combined with the diversity of topics and presentations across the series, the lack of coherence contrasts with the structured progression of a single subject-matter course aligned to explicit learning outcomes. Students stated orally to the organizers that they felt unclear of the relevance of the information, had difficulties in integrating new material, and were struggling with transferring previously acquired knowledge, let alone the cognitive overload when studying the material.

The original final exam

The exams of winter terms 2023/2024 and 2024/2025 contained two to three problems per lecture, with equal weight of the lectures, i.e. each lecture had been given a similar number of achievable credits. The exam problems consisted primarily of single-choice and multiple-choice formats. Its design targeted the first level of the revised Bloom's taxonomy, i.e. remember. Hence, breadth of coverage and validity of the exam had been ensured (ProLehre, 2025a; 2025b). Most exam problems had been drafted by the lecturers, as subject experts, and revised by the organizers, as professional university lecturers. Thereby, adherence to the prescribed taxonomy level and quality criteria for exam problems had been ensured. Multiple students had complained independently about Lecture 9 of the latter term not being preparable for examination — the lecture material consisted of a slide deck of 100 slides on various topics; during the lecture, the lecturer jumped between topics, slides and skipped multiple, such that the material had become too disconnected — hence it had been excluded from the exam.

Figure 1 shows the distribution of the credits achieved by the 72 students who took the exam on basis of the lectures of winter term 2024/2025. 64 credits could be achieved, yet, the highest achieved score is 55, i.e. 86%. Both, the median, and mean scores are 36 credits, i.e. 56%. The standard deviation is $SD = 8.6$ credits. The credits are distributed with a skewness of 0.15 and kurtosis of -0.83, i.e. almost normal distribution. The internal consistency of the exam is assessed with Cronbach's $\alpha_{norm} = \frac{N}{N-1}\left(1 - \frac{\sum_{i=1}^{N} \sigma_{norm,i}^2}{\sigma_{norm,T}^2}\right)$, with N being the Number of Problems, $\sigma_{norm,i}^2$ being the variance of Problem i, and $\sigma_{norm,T}^2$ being the variance over all problems. The subscript $norm$ indicates that the credits of each problem have been normalized to $[0;\ 1]$ with the maximum achievable credits for this problem M_i. For this exam $\alpha_{norm} = 0.65$, indicating an overall consistency, yet, with need of improvement for individual problems.

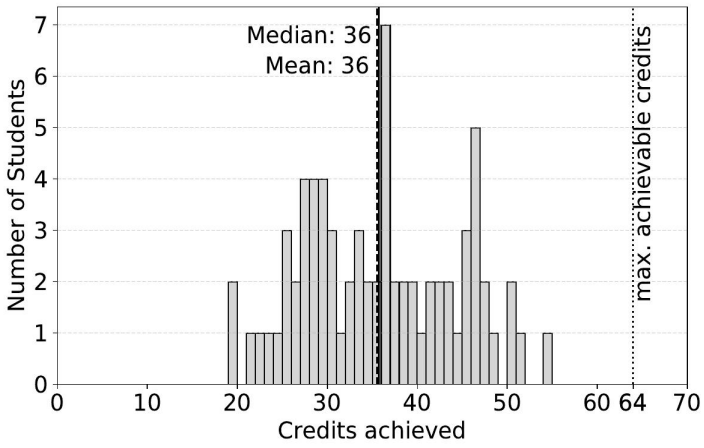

Figure 1: Distribution of Credits per Student (Winter Term 2024/2025). Max. achievable credits = 64; Mean = Median = 36; SD = 8.6 credits.

The outcome of the exam is coherent with the observation that the lecture module design and execution insufficiently support memorization, let alone higher levels of learning. These observations, particularly a ceiling at 86%, $\alpha_{norm} = 0.65$, and a predominance of single- and multiple-choice formats motivate the exam redesign described in Section 3.7.

3. Approach to Fostering an Effective Learning Outcome

To address the challenges identified in Section 2, the lecture series has been systematically redesigned using an integrated didactic approach. The following interrelated measures, building upon one another, span from curricular design, lecturer and subject matter curation, structural coherence, assessment alignment to student communication. These measures form a coherent framework. It targets towards instructional development and quality assurance for the particular learning environment of a practice-oriented, lecture series with changing industry-experts.

Coaching translates these measures into lecture-specific action items, e.g., by focusing the lecture on a single case study instead of multiple or adding a slide at the beginning of the lecture and visualizing three learning outcomes of the lecture and naming the slide "What we will learn today," through a personal meeting between the organizers and the lecturer. The organizers assess the existing or planned lecture materials against the criteria which are detailed in Sections 3.1 to 3.7 and communicate the resulting action items in writing. The lecturer receives an offered review of the revised presentation and exam problems before delivery, allowing organizers to address remaining gaps ahead of the lecture. This mechanism is detailed in Appendix A, with the resulting lecture-specific action items documented in Appendix D.

The measures' effectiveness is assessed through the organizer's ex-post rating of each lecture, student feedback, and quantitative exam analysis, see Sections 3.2, 4.7, and 4.8, respectively. Together they inform a year-end reflection and feed into the subsequent iteration of the series.

Coaching translates these measures into lecture-specific action items. For example, it may focus the lecture on a single case study rather than multiple ones, or make the intended learning outcomes explicit at the beginning of the lecture. In a personal meeting, the organizers and the lecturer discuss the existing or planned lecture materials in light of the principles and criteria detailed in Sections 3.1 to 3.7. Based on this discussion, the organizers provide targeted feedback, and both parties

collaboratively identify suitable measures to address potential gaps and make the lecture more conducive to student learning. The resulting lecture-specific action items are documented in writing and shared with the lecturer. The lecturer is subsequently offered a review of the revised presentation and exam problems prior to delivery. This provides an additional opportunity to discuss any remaining issues and refine the materials. This coaching process is detailed in Appendix A, with the resulting lecture-specific action items documented in Appendix D.

The outcomes of these measures are assessed through the organizers' ex-post rating of each lecture, informal student feedback, and quantitative exam analysis, see Sections 3.2, 4.7, and 4.8, respectively. Together, these perspectives inform a year-end reflection and the further development of the lecture series in its subsequent iteration.

3.1 Defining the Curricular Foundation of the Lecture Series

At first, the curricular foundation for the redesigned lecture series is set. Specifically, it shall be clarified what students should learn, what prior knowledge is expected, and the cognitive level for learning outcomes. All subsequent design decisions in teaching, assessment, and quality assurance are derived therefrom.

The revised module description clarifies the academic value and scope of the lecture series. The module presents a structured exploration of contemporary challenges in risk and safety across different domains. Experts from industry, authorities, and research institutions give lectures based on their experience. They aim to connect theory directly to practical decision-making contexts (TUM, 2025).

Prerequisite knowledge is stated clearly to support competence-oriented learning. Prior knowledge of risk and safety-related concepts provides a scaffold, allowing students to integrate new information and engage in higher-order learning (Sweller, 1988; Vygotsky, 1978). The module description sets these expectations. The lecture series directly signals that it builds on existing understanding and is not an introductory course. This guidance shall align student expectations with the required learning level and reduce cognitive overload during instruction.

The module's overall learning objective is to transfer theoretical knowledge to practical application. To operationalize it, four learning outcomes are explicitly formulated:

After completing the module, the students shall be able to:

- **LO-1:** apply theoretical knowledge from related modules to identify hazards and analyze risks in industrial cases and propose mitigation measures, e.g. hazard identification, incident investigation, clinical studies, organizational adaptation, proper HMI-design, unambiguous status indicators, design adaptation, safeguarding, risk mitigation planning. Related modules are e.g. Probability Theory and Uncertainty Quantification, Reliability and safety analysis, System and Functional Safety, Human reliability, or Risk Management, see (Straub & Teichgräber, 2022).
- **LO-2:** explain typical challenges that safety experts face in industry projects and reflect on their implications using selected case examples from different industries. These challenges may be conflicting stakeholder interests, limited resources, human factors or regulatory misalignment between markets.
- **LO-3:** illustrate solution approaches to these challenges, e.g. application of the ALARP principle, risk prioritization, smart combination of simulations and experimentation.

- **LO-4:** explain how risk-informed decision-making benefits practice, e.g. by quantitative modeling, structured adaptation methods, or accounting for emergent risks systematically.

LO-2, LO-3, and LO-4 have been phrased according to Bloom's taxonomy level 2, understanding; LO-1 has been phrased according to Bloom's taxonomy level 3, apply (Anderson & Krathwohl, 2001). Each lecture shall contribute to these four learning objectives LO-1 to LO-4. Sections 3.3 and 3.5 detail the implementation.

The teaching format shall support the learning: multimedia-supported presentations and illustrative materials foster comprehension through dual coding and help manage cognitive load (Mayer, 2009; Paivio, 1991; Clark & Paivio, 1991). Structured opportunities for discussion shall be integrated to promote engagement and reflection.

3.2 Curating Suitable Lecturers

Originally, speakers were selected solely on the basis of their expertise (i.e., industry and field of work) and their professional experience; see Section 2. In contrast, speakers for the newly structured lecture series must now also demonstrate specific teaching skills.

The quality of each lecture is thus essential for meeting the learning outcomes outlined in Section 3.1. This subsection details the teaching skills lecturers need, to support student learning effectively. To make instructional quality transparent and theoretically sound, we draw on key dimensions of effective teaching: preparation, clarity, engagement, and feedback (Schneider & Preckel, 2017; Hattie, 2023). These dimensions, which describe teaching practices that foster learning across disciplines and formats, serve as evaluative criteria for the lecture series:

- **C1: Preparation of the course** — means planning and organizing a lecture by first anticipating the audience, their prior knowledge, skill level, and learning environment, and then designing a lecture that fits. It states the intended outcomes explicitly, aligns content, teaching activities, and assessment with those outcomes, and sequences material in a logical progression toward them.
- **C2: Clarity of the content** — means delivering instruction clearly and expressively. It includes explaining complex ideas simply and with good examples, using precise, accessible language, and organizing content to aid understanding and engagement.
- **C3: Social interaction in class** — means engaging well with others during lectures. This includes creating an environment where students feel comfortable asking questions, joining discussions, and seeking clarification. This competence also requires being approachable, respectful, and responsive. Together, these qualities support motivation, participation, and belonging.
- **C4: Monitoring the learning process** — means the lecturer is aware of how students are progressing and responding to teaching. This covers giving timely feedback, checking students' understanding during lectures, and using cues to adjust explanations, examples, or pacing when needed.

The organizers curate novel lecturers, from different industries and with different roles, based on the expectation to meet criteria C1 – C4; the expectation derives from previous work with these lecturers. Rating lectures ex post against these criteria enables formative feedback and targeted instructional development[3]. As a last resort, the criteria provide a transparent basis for summative decisions regarding individual lecturers.

[3] The organizers attend the lectures and take notes during these, which are reviewed afterwards and supplemented with out-of-class observations on lecturer performance.

3.3 Curating Subject Matters for Transdisciplinary Coherence

A subject matter is the combination of an application domain with a specific content focus. A key goal of the lecture series is transdisciplinary exploration of risk and safety cases. This is achieved through diversity across subject matters. This diversity is pedagogically valuable as it allows students to compare approaches, constraints, and decision-making practices across industries and roles. Yet, excess diversity risks fragmentation, if topics lack a clear connection to the shared learning outcomes of the lecture series, see Section 3.1.

Therefore, topic selection and refinement follow a curatorial process; it is actively led by the organizers:

- The curated lecturers, that are expected to demonstrate the described teaching competences or have demonstrated these in a previous lecture, originate from different industries and have different roles. Given their diverse application domain, they present a diverse professional perspective on the theme of the lecture series.
- They contribute with their deep subject matter expertise and are invited to propose a content focus which is based on their work.
- The content focus is discussed with the organizers and shaped collaboratively to match it with the other lectures to allow for a diverse, yet, coherent exploration of the theme.

The organizers curate thereby for two purposes: First, curation supports competence-oriented learning by ensuring lectures address challenges, solutions, and decision contexts aligned with the learning outcomes. Second, it shall prevent cognitive overload by avoiding thematic drift or fragmentation. This process assesses content focus, not lecturers, and steers the alignment with the didactic concept.

3.4 ARIVA as a Framework for Learning-Supportive Lecture Structure

While diversity through subject matters defines the lecture series, it also risks structural inconsistency across individual lectures. The heterogeneity of lecturers with not necessarily pedagogic training, stemming from different industries and roles may lead to fragmentation of the lectures. Navigating through heterogeneous instructional formats may divert attention from content. To mitigate this, a shared structural framework establishes coherence while preserving diverse lecturing styles and disciplinary perspectives. Concretized, drawing on the ARIVA framework as an analytical lens, see Section 1, three recurring structural elements are to be implemented in each lecture:

- An introductory element that states and visualizes the intended learning outcomes and situates the topic within the lecture series. It supports orientation and cognitive readiness. It represents the arrive phase.
- A concluding element that summarizes and visualizes the key takeaways relative to the stated outcomes, supporting consolidation and reflective evaluation of the lecture content. It realizes the evaluate phase.
- A reflective problem or guiding question grounded in professional practice. It is to be situated after the concluding element. It stimulates discussion, active engagement and guides self-study. It thereby implements the process phase.

Together, these elements reduce extraneous cognitive load, facilitate comparison across diverse topics, and support metacognitive awareness. Structural coherence is understood as a collective quality of the series, not an individual style requirement; deviations are addressed through dialogue rather than enforcement.

For lecturers coached by the organizers, this dialogue is complemented by practical support in implementing the three structural elements. Rather than merely prescribing their use, the organizers provide example slides and sample formulations of learning outcomes and key takeaways. Lecturers adapt these examples to their own session, and the resulting formulations are discussed and refined in a follow-up as part of the coaching process. This support may be particularly useful for lecturers with limited formal pedagogical training.

Note that while the lecture series follows a shared theme, each session is delivered by a different industry expert on and different subject matter. In contrast to a classical lecture module, these sessions do not consecutively build upon each other. Hence, reactivation of information of the preceding lecture session, i.e. the reactivation phase, is not applicable in this sense.

3.5 Promoting Constructive Alignment Through Assessment-Oriented Design

Constructive alignment requires coherence between learning outcomes, instructional activities, and assessment. The redesigned lecture series embeds this alignment into lecture preparation. As a central measure, lecturers draft three short-question-type exam problems during preparation. These are to be aligned with the learning outcomes and taxonomy levels defined in Section 3.1.

This serves two purposes. First, this clarifies the intended learning outcomes and encourages lecturers to reflect on which concepts, processes, or forms of understanding students should demonstrate after the lecture, and how to prepare the students by means of the lecture. Thereby, instead of treating assessment as separate, summative measure, alignment becomes part of lecture preparation. Second, the drafts provide a base for the module exam. They are didactic tools, not final assessment items.

The organizers review and refine all draft problems with the lecturers to ensure consistency with the intended taxonomy levels. This shared process fosters a common understanding of learning outcomes across the series and keeps constructive alignment a collective responsibility.

3.6 Fostering Deliberate Advance Lecture Preparation

Enforcing early submission of materials supports designing an effective lecture. It supports lecturers in meeting the pedagogical requirements of the series, counteracting the conference-presentation socialization documented in Section 2 (Loughlin & Lindberg-Sand, 2023; Gerstein, 1995). Specifically, early preparation enables lecturers to anticipate the audience and structure the lecture accordingly (C1), to implement the structural elements described in Section 3.4, and to embed constructive alignment into the design and draft exam problems aligned with the learning outcomes, see Sections 3.1, 3.5.

Lecturers are therefore requested to submit materials at least 24 hours before their lecture, with a reminder sent 36 hours in advance. This deadline compels early, deliberate engagement with the pedagogical requirements of the series. Early availability of materials carries a secondary benefit for students: pre-class access allows construction of foundational knowledge before the lecture, reducing cognitive load and freeing capacity for processing complex concepts (Clark & Paivio, 1991; Mayer, 2009). Early submission is a structural support measure. Reliability in submission is an observable sign of preparation within C1.

3.7 Designing a Valid and Fair Examination

Assessment determines whether the lecture series achieves its intended learning outcomes. In the redesigned format, the written examination is an integral part of the didactic concept rather than an isolated summative measure.

At the end of the module, students take a 60-minute written exam, which counts for 3 ECTS credits. The exam tests conceptual understanding and application at the taxonomy levels set in the learning outcomes in Section 3.1.

Exam design builds on the draft problems developed during lecture preparation, Section 3.5. Lecturers are responsible for providing subject-matter expertise by proposing content-relevant questions. Organizers are responsible for the didactic quality and coherence of the lecture series. Specifically, organizers review and refine all drafted problems, not only to ensure constructive alignment as in Section 3.5, but to also ensure high-quality problems: they avoid ambiguity, use action verbs consistently, improve clarity and frame the problems to elicit understanding and application rather than factual recall (ProLehre, 2025a; 2025b).

To ensure reliability and balance, exam questions differ in difficulty and task type. Tasks include conceptual comparisons, explanation-based prompts, interpretation of scenarios or data, and cause-and-effect reasoning. We also promote validity by distributing achievable credit points evenly across lectures. No single lecture disproportionately affects the overall exam result.

Students also relate individually to the various subject matters. To account therefore, the exam is designed with an overhang to compensate for two of ten subject matters, strengthening fairness of the exam. By distributing credit points evenly, incorporating an overhang, and centralizing problem refinement, the exam provides a fair and transparent measure of student learning across the series.

3.8 Clarifying Expectations to Students

Valid assessment and instructional alignment work only if students understand what is expected of them and how to engage with the lecture series. To support this, the redesigned lecture series explicitly communicates learning outcomes, instructional structure, and assessment expectations to students. We communicate expectations verbally and in written form and at several occasions during the semester.

Students are explicitly informed of the lectures' shared structure, see Section 3.4. They are encouraged to use recurring elements as orientation points. Students should refer to these when reviewing material, organizing notes, and preparing for exams. Clarifying expectations directs students to adopt effective learning strategies, reduces uncertainty about assessments, and ensures that learning outcomes and instructional quality are evaluated in clearly defined terms. This process contributes to fairness and transparency in the lecture series' quality assurance.

Together, these measures transform the lecture series from loosely coupled expert presentations into a coherent learning environment aligned with competence-oriented pedagogy. Appendix D details how these conceptual measures are operationalized and applied to individual lectures.

4. Observed Effects of a Framework-Guided Redesign

This section presents the results of the framework-based approach outlined in Section 3. It combines insights from the lecture-level implementation and a follow-up observation cycle. Instead of analyzing causal effects on student learning outcomes, the analysis focuses on how the framework-informed measures have been implemented, how teaching practices have evolved over one iteration, and which indicators point to more effective learning conditions. The findings demonstrate how a structured, criteria-based set of methods supports decision-making and quality enhancement in a multi-expert-lecturer course series.

4.1 Implementation of Framework-Guided Measures

Table 3 summarizes the lecture-level ratings for the winter term 2024/2025. It covers teaching competences, promotion of learning objectives, and alignment with lecture structure and constructive alignment. All lecture-level criteria have been rated on a three-point scale (0 = not fulfilled, 1 = partially fulfilled, 2 = fully fulfilled) based on ex post analysis of lecture materials and observed delivery. Teaching competences have been rated according to the criteria C1–C4, see Section 3.2. In addition, each lecture has been assessed on how effectively it promoted the learning objectives LO-1 to LO-4. Structural alignment with the ARIVA framework has been rated using the same scale. Full alignment has been assumed when a lecture has implemented the three recurring structural elements specified in Section 3.4. Constructive alignment (CA) has been rated based on the alignment between lecture content and associated exam items with the prescribed taxonomy levels. The early availability of lecture materials, see Section 3.6, has been treated as a supportive indicator related to preparation (C1) and considered as part of the lecture-level assessment. Based on the assessment, we have derived individual intervention measures.

Overall, most lecturers demonstrate a high level of teaching competence. Deficiencies were predominantly prevalent in C1 and C4: the preparation of the course and the monitoring of the learning process. Nearly all of the lecturers had low scores in fit to the intended learning outcomes, ARIVA, and Constructive alignment.

Table 3: Assessment of lecturers, lectures, and subject matter for Winter Term 2024/2025. Rating scale: 0 = not fulfilled, 1 = partially fulfilled, 2 = fully fulfilled.

ID	Lecturer	Industry	Topic of Lecture	C1	C2	C3	C4	LO-1	LO-2	LO-3	LO-4	ARIVA	CA
L1	UlNi	Medical	Certification of Conformity of Medical Devices	2	2	2	1	2	1	1	2	1	1
L2	LuDr / MoWe	Automotive	Probabilistic Safety Modeling & Simulation	1/2	2	2	1	2	2	2	2	0	0
L3	MaTr	Automotive	Passive Safety Testing	0	1	2	2	1	0	0	2	0	0

L4	RiMu / LuBe	Aviation	Safety Management System	1	2	2	1	1	1	2	2	1	0
L5	AnLa	Insurance	Env. Risks Modeling	1	2	1	0	1	2	2	1	0	1
L6	ReiRo	Automotive	Human Factors Engineering	2	2	1	2	1	2	1	2	1	1
L7	BjMa	Emergency Response	Fire Risk Mitigation	1	1	2	0	1	2	1	2	0	0
L8	MaSc	Civil Engineering	Structural Reliability & Public Safety	2	2	2	2	2	2	2	2	1	2
L9	MaRo	Mobility	Functional Safety of AI	0	1	2	0	1	1	0	1	0	0
L10	RaSa	Insurance	Uncertainty in Risk Modeling	1	2	2	1	1	2	1	2	0	0

Table 4: Assessment, applied measures, and decisions for Winter Term 2024/2025.

Lecture	Dominant Deficiencies	Measures Applied (ref. Sec. 3)
L1	Over-specificity on standards; limited LO-2 & 3 depth	Limit takeaways to three; Integrate LO-2 & 3; Improve coherence (Sec. 3.4); Improve CA to higher taxonomy levels (Sec. 3.5)
L2	ARIVA absent; no CA; too high density of information; unclear focus	Content focus (Sec. 3.3); ARIVA structuring (Sec. 3.4); Improve coherence (Sec. 3.4); CA redesign (Sec. 3.5) and coaching
L3	Low C1 and credibility (C3); ARIVA absent; LO-1 poorly addressed and LO-2 & 3 not addressed	Lecturer replacement (Sec. 3.2); content alignment (Sec. 3.3); ARIVA structuring (Sec. 3.4); CA redesign (Sec. 3.5)
L4	Acronym overload; unclear focus; weak LO-1 & 2	Lecturer remediation (Sec. 3.2); ARIVA structuring (Sec. 3.4); CA redesign to higher taxonomy levels (Sec. 3.5); reduce and explain acronyms
L5	Lack of A and R phases	ARIVA structuring (Sec. 3.4); Explain the business as Activation, Modeling approaches as Reactivation; CA to higher taxonomy levels (Sec. 3.5)

L6	ARIVA weak; weak LO-1 & 3	ARIVA structuring; content alignment to theoretical background (Sec. 3.3)
L7	ARIVA absent; no focus and lack of consolidation; no CA	Lecturer remediation (Sec. 3.2); ARIVA structuring (Sec. 3.4); content alignment (Sec. 3.3); Focus of Content to two stories and takeaways; CA redesign and coaching (Sec. 3.7)
L8	Acronyms undefined; Terminology inconsistency; too much content	Improve coherence (Sec. 3.4); focus of content to two projects; CA to higher taxonomy levels (Sec. 3.5)
L9	ARIVA absent; very weak alignment to LO-1–4; Content overload; unclear focus; no CA	Lecturer replacement (Sec. 3.2)
L10	Weak LO-1 & 3; no ARIVA; no CA	Content alignment (Sec. 3.3); ARIVA structuring (Sec. 3.4); CA redesign to higher taxonomy levels (Sec. 3.5)

Therefore, the interventions target, first and foremost, content relevance, lecture structure, constructive alignment, organizational reliability, assessment design, and lecturer skills. The focus is on translating the defined criteria into practical expectations and actions. Hence, each lecturer has received detailed briefings, written instructions, and, if needed, personalized coaching. By translating the measures into specific lecture-related action items (Appendix D), expectations have become explicit and actionable, addressing the work culture of the industry expert lecturers, see Section 2. Table 4 highlights the initial evaluation of lectures for Winter Term 2024/2025 and records the measures taken to address deficiencies. Interventions included structural alignment, content adjustments, lecturer coaching, and replacements. These changes have laid the foundation for a revised lecture series in the following term.

4.2 Revised Lecture Series After One Intervention Cycle

Based on the assessment and targeted interventions, the lecture lineup and designs have been updated for Winter Term 2025/2026. Table 5 shows the revised lecturer lineup. The changes involved replacing one lecturer, onboarding new ones from additional sectors, and continuing with returning lecturers who contributed to refinement and remediation. Consequently, the lecture series broadened its transdisciplinary scope while remaining aligned with the learning objectives, see Section 3.1. In addition, previously identified issues in preparation, structural coherence, and constructive alignment have been addressed explicitly.

4.3 Assessment Against Defined Criteria After One Iteration

Table 6 shows a systematic evaluation of the lecture series after the implementation of the measures against the criteria outlined in Section 3. Compared to the initial lecture series, preparation (C1) has improved for many returning lecturers, especially those who incorporated structural elements and clarified learning objectives. Content clarity (C2) and social interaction (C3) have remained consistently high across. Monitoring the learning process (C4) has improved when lecturers integrated feedback and documented their processing activities. Alignment with learning objectives (LO-1 to LO-4) has improved notably throughout the series. Some lectures have fully covered all objectives, while

others have shown targeted enhancements in specific areas. These patterns indicate that transparent communication of expectations and focused support can promote more consistent alignment in multi-lecturer courses.

4.4 Observed Changes in Teaching Practices

Table 7 highlights observed improvements and remaining gaps in lectures delivered during Winter Term 2025/2026. Several patterns have emerged across the series, indicating changes in teaching methods compared to the baseline term. First, the majority of lecturers have improved structural coherence in comparison to Winter Term 2024/2025. More lecturers have set explicit learning objectives and provided clear takeaways, which has enhanced orientation and closure. Only one of the lecturers has not reflected on learning process (C4). Every intended learning outcome is promoted in the lecture, and ARIVA is also incorporated into its structure. Constructive alignment has room for improvement. Content has been streamlined and reorganized around key ideas or cases, reducing information overload and creating a more straightforward narrative. Second, alignment with learning objectives has improved, as returning lecturers frequently adapted their content to better meet application and reflection goals, while new instructors generally aligned well with understanding goals. However, applying application-oriented objectives (LO-1) has remained challenging, especially for those without prior teaching experience. Third, changes in interaction and monitoring practices have been observed: although many interactive elements have been delivered orally rather than through documented activities, some lecturers have incorporated discussions, reflective prompts, and applied tasks more intentionally than before.

4.5 Structural Coherence and the ARIVA Framework

The ARIVA framework provides a shared basis for organizing lectures. Observed improvements are noticeable across its stages. The Arrive phase has focused more on learning outcomes and less on company introductions, though some lecturers have used it mainly to frame the business context. Explicit Reactivate phases are rare; instead, prior knowledge has commonly been reactivated implicitly alongside content delivery. The Inform phase has remained strong in all lectures, with improvements through clearer segmentation of topics, visual hierarchical structuring, and analytical frameworks. The Process phase has often been executed via oral discussion, but documented activities have been limited to a few lectures. The Evaluate phase has improved due to the takeaway slides, though reflective slides have been used inconsistently. Overall, the ARIVA framework has served more as abstract guidance than a strict template.

4.6 Constructive Alignment and Assessment-Related Practices

Constructive alignment has improved from a mean rating of 0.5 in Winter Term 2024/2025 to 1.2 in Winter Term 2025/2026, see Tables 3 and 6. In the first term, seven of ten lectures received $\mathrm{CA} = 0$. After structured briefings, documented personalized action-items, and coaching, nine of ten lectures have received a score of at least one.

Constructive alignment is assessed through the alignment between lecture content, exam problems, and the prescribed taxonomy levels, see Appendix B. This is an indirect proxy: it captures the degree of alignment of these three components during one single lecture; it is not based on observing the teaching process throughout a term. Lecturers who explicitly stated learning objectives and structured their lectures to the focused takeaways at the intended taxonomy levels, and aligned the drafted exam problems achieved a higher rating. Those who focused primarily on content delivery had a lower rating. We also observed that these were the ones who had difficulties in formulating proper exam problems at the intended taxonomy level.

4.7 Indicative Effects on Learning Conditions

Beyond lecture-level observations, student evaluations provide insights into the learning environment. The Winter Term 2024/2025 assessment gathered seven responses; the Winter Term 2025/2026 evaluation involved 29 students. Ratings improved across all assessed dimensions from one term to the next, with the overall grade rising from a mean of 3.0 to 1.9. The most pronounced gains are observed in structure, clarity, and practical relevance. Competence development shows a marginal improvement (mean 2.8 to 2.6), remaining the relatively weakest-rated dimension in both terms. At least 67% of students in Winter Term 2024/2025 rated lecturers positively across all assessed dimensions: preparation, clarity, availability, responsiveness, and interest in student learning. This improved to at least 89% of all students in Winter Term 2025/2026 giving a positive rating. The detailed student evaluation analysis is provided in the supplementary materials (Appendix E).

4.8 Indicative Effects of the Redesign on Examination Quality

The comparison of the written examinations of Winter Terms 2024/2025 and 2025/2026 indicates several improvements in assessment quality.

Internal consistency improved substantially: Cronbach's α_{norm} rose from 0.65 to 0.85. The proportion of problems meeting the minimum discrimination threshold $r_i \geq 0.30$ increased significantly. While in 2024/2025 less than 30% of the problems had a higher r_i, and even two problems indicated a negative r_i, in 2025/2026 85% of the problems were above $r_i \geq 0.30$ and none negative. The mean r_i rose from $\bar{r}_i = 0.227$ for exam of winter 2024/2025 term to $\bar{r}_i = 0.427$ for exam of winter 2025/2026, which is 88% relative increase. Both improvements are consistent with the systematic shift toward short-answer format, which the 2024/2025 data already identified as the primary driver of discrimination, and with the lecture-level quality gains documented in the above subsections.

The standard deviation widened from 8.6 to 12 credits, and the excess kurtosis increased slightly, both reflecting improved differentiation. Both distributions exhibit near-zero, almost identical, skewness, indicating no systematic directional bias.

The mean score decreased from 36 to 31 credits despite the 2025/2026 exam incorporating a 20% credit overhang, see Section 3.7. This fits with deliberately targeting higher taxonomy levels, leading to a more challenging exam. The maximum achieved score of 58 credits, i.e., 92% of the practical ceiling of 63, confirms that high-performing students can indeed perform high; the 86% ceiling observed in 2024/2025 is resolved.

Several connections between lecturer quality improvement and exam problem performance are observable. L2, in both terms, improved from ARIVA $= 0$ and CA $= 0$ in 2024/2025, where all three problems showed uniformly low to negative discrimination, to ARIVA $= 1$ and CA $= 1$ in 2025/2026, where both problems achieved good discrimination. L3 improved CA from 0 to 1; exam problems moved from low discrimination to good and very high discrimination despite comparable difficulty, suggesting that improved constructive alignment, rather than difficulty level, drives discriminating power. UlNi, L1 in 2024/2025 and L6 in 2025/2026, achieved full ratings across all criteria including ARIVA $= 2$ and problems became harder and better discriminating, with the sole exception of the single-choice item discussed below. RaSa, L10 in 2024/2025, L7 in 2025/2026 improved ARIVA from 0 to 1; discrimination improved from one negative item and two weak ones to consistently high values across both problems, despite CA remaining at zero. LuBe, part of a two-lecturer team for L4 in 2024/2025 with ARIVA $= 1$ and CA $= 0$, delivered L1 as a sole lecturer in 2025/2026 with ARIVA $= 2$ and CA $= 1$; problems shifted from too easy with acceptable discrimination to difficult and very difficult with good discrimination. MaSc, L8 in both terms, maintained full ratings throughout and produced the most consistently well-discriminating problem cluster in both exams.

The impact of structured onboarding and organizer-led exam coaching is most directly visible in the novel lectures L4 (ElBi) and L5 (BeKe), for whom no prior-term baseline exists. Both received personal briefings, written action-item lists, and organizer review of exam problems; for L4, the organizers authored the exam problems directly as ElBi failed to deliver any. Despite this, ElBi achieved $\mathrm{ARIVA} = 1, \mathrm{CA} = 1$, and Problems 7 and 8 both show high discrimination at medium to difficult levels. L5 achieved $\mathrm{ARIVA} = 1, \mathrm{CA} = 1$; Problems 9 and 10 show good discrimination at medium difficulty. These outcomes suggest that structured onboarding combined with organizer overall ownership of exam design positively impacts the outcome.

A particularly informative observation arises from one problem that is identical in both exams: Problem 2 in 2024/2025 and Problem 12 in 2025/2026, originate from the same lecturer (UlNi). His teaching quality had been considered high in winter term 2024/2025, and improved in the subsequent term. Yet, the item's discrimination decreased slightly. This isolates format as the binding constraint: an easy single-choice item, which can either be credited full or not, has low predictive power within a harder, coherent exam built around demanding short-answer problems, with partial credit scoring, independent of content quality. This confirms single-choice formats should be avoided regardless of lecturer quality.

Lecture clusters L1 and L7 in 2025/2026 consistently yielded difficult problems with lower mean scores. This reflects the difficulty in the subject matters of aerospace safety management and emerging technology risks rather than assessment misalignment as both clusters show good to high discrimination. Within-lecture calibration remained uneven in some cases: Problem 17 of L9, 2025/2026 is almost always full credited even for low performers, contrasting with the high discrimination of adjacent Problem 18. This confirms that targeted problem-level calibration is necessary and intra-problem calibration needs to be emphasized.

Overall, the exam data corroborate the lecture-level observations: framework-guided measures translate into a more coherent, valid, and discriminating assessment.

4.9 Scope and Limits of Interpretation

The results reported do not permit direct causal conclusions about individual items' effectiveness, as several interconnected measures have been implemented simultaneously. A direct comparison of the exam outcomes cannot be made due to different exam structures, design, level of learning, cohort sizes, and constellation.

Consequently, the findings should be viewed as descriptive and indicative of a framework-guided redesign process. They demonstrate how systematic criteria, clear expectations, and targeted support can influence teaching practices and learning environments in a complex lecture series. These results serve as a basis for reflection and further development rather than definitive proof of learning outcomes.

Table 5: Characteristics of the lecturers for Winter Term 2025/2026.

Lecturer	Lecture	Industry	Field of Work	Level of expertise
LuBe	L1	Aerospace	Safety Management	Intermediate
MoWe / LuDr	L2	Automotive	Probabilistic Safety Modeling & Simulation	Senior / Intermediate
BjMa	L3	Emergency Response	Fire Risk Mitigation	Senior
ElBi	L4	Energy	Artificial Intelligence, Reliability, Availability	Intermediate
BeKe	L5	Financial Services	Risk Modeling and Management	Senior
UlNi	L6	Medical	Clinical Reviewer for Medical Devices	Senior
RaSa	L7	Insurance	Qualitative Risk Modeling	Senior
MaSc	L8	Civil Engineering	Risk-informed engineering	Senior
VaZi / StLo	L9	Automotive	Passive Safety Development & Testing	Senior
AnLa	L10	Insurance	Environmental Risks Modeling	Intermediate

Table 6: Assessment of lecturers, lectures, and subject matter for Winter Term 2025/2026.

ID	Lecturer	Industry	Topic of Lecture	C1	C2	C3	C4	LO-1	LO-2	LO-3	LO-4	ARIVA	CA
L1	LuBe	Aviation	Safety Management	2	2	2	1	2	1	2	2	2	1
L2	MoWe / LuDr	Automotive	Probabilistic Safety Modeling & Simulation	2/1	2	2	1	2	2	2	2	1	1
L3	BjMa	Emergency Response	Fire Risk Mitigation	1	2	2	0	2	2	2	2	1	1
L4	ElBi	Energy	Modeling with and Application of AI	1	2	2	1	2	2	2	2	1	1
L5	BeKe	Financial Services	Management of ESG risks on businesses	2	2	2	1	1	2	2	2	1	1
L6	UlNi	Medical	Certification of Conformity of Medical Devices	2	2	2	2	2	2	2	2	2	1
L7	RaSa	Insurance	Risks of Emerging Technologies	1	2	2	2	1	2	2	2	1	0
L8	MaSc	Civil Engineering	Structural Reliability & Public Safety	2	2	2	2	2	2	2	2	2	2
L9	VaZi / StLo	Automotive	Passive safety testing	2	2	2	2/1	1	2	2	2	1	2
L10	AnLa	Insurance	Env. Risks Modeling	2	2	1	1	2	2	2	2	1	2

Table 7: Observed improvements and remaining deficiencies per lecture, Winter Term 2025/2026.

Lecturer	Lecture	Improvements	Remaining Deficiencies
LuBe	L1	Learning objectives slide implemented with question-based framing; takeaways slide with visual synthesis; oral integration of Processing and Evaluate phases; acronyms reduced and explained; more meaningful slide titles and visual hierarchy; single-lecturer format improved focus; explicit reference to prior knowledge (LO-1).	Processing and Evaluate phases need documentation; ARIVA phases (Sec. 3.4); reflective-problem slide missing (Sec. 3.4); lecturer expressed inability to draft exam problems at taxonomy levels 2–3.
MoWe / LuDr	L2	Provision of foundational knowledge, also serving as Reactivation, yet unphased; inclusion of methodological comparison; clearer section transitions; oral implementation of Processing and Evaluate phases.	Focus of content (Sec. 3.3); ARIVA phases (Sec. 3.4); motivational slide absent, no dedicated takeaway slide with 2–3 tangible aspects (Sec. 3.4); CA redesign (Sec. 3.5).
BjMa	L3	Takeaway slide with three aspects has been included; analytical framing of the lecture; content has been focused; structural slides have been included; CA elevated to higher taxonomy levels (Sec. 3.5).	ARIVA phases (Sec. 3.4); explicit learning outcomes and reflective-problem slides absent (Sec. 3.4); content alignment (Sec. 3.3); focus of content to two cases; CA redesign (Sec. 3.7).
ElBi	L4	New lecturer.	Early preparation for the course (C1); explicit reactivation phase absent; Processing and Evaluate phases need documentation (Sec. 3.4); reflective problem slide absent (Sec. 3.4); lecturer expressed inability to draft exam problems at taxonomy levels 2–3.
BeKe	L5	New lecturer.	Reactivate phase absent; Processing and Evaluate phases need documentation (Sec. 3.4); reflective problem slide needed (Sec. 3.4); application of

			theoretical knowledge (LO-1) weak (Sec. 3.3).
UlNi	L6	Learning objectives reduced from five to three; all ARIVA phases have been addressed; structural consistency elements implemented; CA to higher taxonomy levels (Sec. 3.5); LO-2 and 3 have been integrated.	Reflective problem slide needed (Sec. 3.4).
RaSa	L7	Focusing of the content; documented takeaways on the board and integrated these into lecture; company introduction has been reduced; oral integration of Processing and Evaluate phases; addressing of LO-1 and LO-3.	Processing and Evaluate phases need documentation; ARIVA phases (Sec. 3.4); structural consistency elements absent (Sec. 3.4).
MaSc	L8	Structural consistency elements implemented; ARIVA phases have been addressed; focus of content to one case; CA to higher taxonomy levels (Sec. 3.5).	Terminology glossary slide recommended.
VaZi / StLo	L9	Depth of content (Sec. 3.3); ARIVA structuring (Sec. 3.4); structural slides have been included; learning objectives and takeaways have been highlighted; CA redesign (Sec. 3.5).	Reactivation phase absent; application of theoretical knowledge (LO-1) weak (Sec. 3.3).
AnLa	L10	Structural consistency elements implemented; LO-1 and 4 realized; CA to higher taxonomy levels (Sec. 3.5); reactivation of background knowledge has been integrated; content density reduced through clearer topic segmentation.	Reflective problem slide needed (Sec. 3.4); Process and Evaluate phases not integrated (Sec. 3.4); number of takeaways needs to be reduced.

5. Concluding Discussion

5.1 Discussion

The results demonstrate that translating abstract pedagogical principles into concrete, lecture-specific action items enables industry experts to produce more coherent, outcome-oriented lectures. This finding is consistent with the observation that industry experts, socialized as conference presenters rather than academic teachers, reproduce presentation formats unless explicitly guided otherwise (Loughlin & Lindberg-Sand, 2023; Gerstein, 1995). Providing specific structural requirements, such as a learning objectives slide, a focused takeaway slide, and a reflective problem, improved the structural coherence across the series: ARIVA alignment rose from a mean of 0.4 to 1.3, and every lecture in Winter Term 2025/2026 achieved at least partial ARIVA alignment, compared to six of ten receiving no alignment in the preceding term.

A clear implementation gradient emerged across measure types. Structural elements with prescribed formats, namely the learning objectives and takeaway slides, have been adopted by the majority of lecturers. Elements requiring deeper pedagogical design, in particular the reflective problem slide, explicit Reactivation phases, and documented Process activities, remained consistently underdeveloped. This gradient reflects the professional socialization of the lecturers: content delivery is their primary frame of reference, while designing activities for active knowledge processing requires a pedagogical orientation that most industry experts have not developed (Deslauriers et al., 2019). The Inform phase therefore remained the dominant phase across both terms, with improvements in how it was structured and segmented rather than in the balance of phases.

Constructive alignment improved substantially: from seven of ten lectures failing in 2024/2025 to only one in 2025/2026. Yet, constructive alignment remained the most challenging dimension to implement fully (Biggs, 1996). Lecturers who explicitly structured their lectures around a small number of focused takeaways showed consistently better alignment between intended learning outcomes and assessment prompts. Drafting exam problems during preparation served as a productive reflective tool: it surfaced misalignments early and encouraged dialogue with the organizers. Where lecturers were unable to formulate problems at the intended taxonomy levels (Anderson & Krathwohl, 2001), the organizers took full ownership.

No consistent relationship was found between the teaching competence ratings C1–C4 and ARIVA or constructive alignment scores. This is not surprising: C1 captures preparation competence broadly, of which instructional design is only one component, and C2–C3 reflect delivery and interaction qualities that are orthogonal to structural design decisions. Hence, high teaching competence is a necessary but not sufficient condition for competence-oriented instructional design, and explicit structural requirements must supplement competence-based expectations.

The written examination provides corroborating evidence. Cronbach's α_{norm} rose from 0.65 to 0.85, and the proportion of problems meeting the minimum discrimination threshold of $r_i \geq 0.30$ increased from below 30% to 85%. The lower mean score in 2025/2026 (31 vs. 36 credits) is a direct consequence of targeting higher taxonomy levels and replacing single- and multiple-choice formats with short-answer problems, and is not indicative of reduced learning. The absence of a ceiling effect and the wider score distribution confirm that the redesigned exam is both more demanding and more discriminating. The repeated observation that a single-choice item authored by the highest-rated lecturer showed comparably low discrimination in both terms, despite improved teaching quality, isolates question format as the binding constraint on discriminating power, independent of content or lecturer quality.

5.2 Summary

This work demonstrates that a practice-oriented lecture series with industry-expert lecturers can be systematically redesigned toward competence-oriented, constructively aligned learning without requiring pedagogical expertise from individual lecturers. The operative contribution is a framework of interrelated measures, building on each other, translatable into concrete, lecture-specific action items, which together establish structural coherence, thematic focus, and assessment alignment while preserving diversity in teaching styles and disciplinary perspectives. The framework is applicable to both novel and established lecture series in engineering and professional education, and the operative artifacts provided support implementation without requiring external pedagogical expertise.

5.3 Implications

The framework offers several transferable lessons for educators managing practice-oriented lecture series with industry experts. Conceptual frameworks such as ARIVA and constructive alignment must be translated into concrete, lecture-specific action items, as abstract principles alone do not change practitioner behavior (Loughlin & Lindberg-Sand, 2023). Mandating a small number of structural elements, rather than prescribing a full teaching template, establishes sufficient coherence while preserving individual styles and industry perspectives. Requiring lecturers to draft exam problems during preparation is a low-threshold mechanism that surfaces misalignment early and makes constructive alignment a shared responsibility; however, organizers must be prepared to take full ownership of assessment design when lecturer expertise does not extend to higher-taxonomy formulation. The Arrive, Process, and Evaluate phases of ARIVA consistently require more intensive organizer involvement than structural framing alone can provide, and their realization benefits from worked examples and closer collaborative development with lecturers. The framework's primary mode is formative: coaching and targeted support take precedence over replacement. Lecturer replacement occurs when deficiencies remain after clarifying expectations and support has been provided. Novel lecturers, who are onboarded with specific action items and a personal briefing, achieved comparable outcomes to returning lecturers, indicating that structured onboarding is effective and replicable.

5.4 Limitations

Four persistent deficiencies remain after one intervention cycle. The reflective-problem slide showed the lowest implementation rate across the series: only one lecturer consistently provided documented discussion tasks. The reactivation phase was not used in the sense of reactivating content from the preceding session, as the individual lectures did not build on one another sequentially. However, reactivation also remained underdeveloped as a distinct instructional phase for activating relevant prior knowledge from preceding modules of the curriculum. Instead, foundational knowledge was typically revisited implicitly during content delivery rather than through dedicated reactivation activities. The Process and Evaluate phases have predominantly been implemented orally and are not documented in lecture materials, limiting their utility for independent student study. Several lecturers were unable to formulate exam problems at the prescribed Bloom's taxonomy levels of 2 and 3, reflecting their orientation toward content presentation rather than competency development (Anderson & Krathwohl, 2001).

Three methodological limitations constrain the interpretation of the findings. First, multiple interventions were introduced simultaneously: structural guidance, coaching, assessment redesign, and lecturer replacement. This prevents attributing observed improvements to any individual measure. Second, constructive alignment is assessed through an indirect proxy for stand-alone lectures, not an entire module with several tightly aligned lectures. Third, the teaching competence ratings C1–C4 are based on organizer judgments applied to observable indicators in lecture materials and delivery. Fourth, the student evaluations are limited by the small and substantially different samples across the two iterations (n=7 and n=29), resulting in low statistical power and restricting the comparability

between cohorts. Moreover, the use of a standard course evaluation provided only limited insight into students' perceptions of individual lecture sessions, thereby constraining the assessment of session-specific effects and areas for improvement. Both authors rated independently and discrepancies were resolved through discussion, but the evaluators are also the course organizers, which introduces a potential confirmation bias that cannot be fully eliminated.

The study reflects a single educational context: a Master's-level lecture series in engineering risk and safety at one institution, assessed over two consecutive terms with cohorts of 72 and 55 students respectively. The small and asymmetric cohort sizes limit the statistical power of the exam comparison, and the single-institution context limits the generalizability of the findings to other disciplines, institutions, and lecture series structures.

5.5 Future Work

Three directions are indicated by the persistent deficiencies and methodological constraints identified above. First, the reflective-problem slide, reactivation phase as reactivation of foundational knowledge, and documented process activities require stronger targeted support beyond written action items. Providing lecturers with detailed templates for reflective problems, references to lecture modules for a reactivation slide, and a reference exam showing problems at the intended taxonomy levels would reduce the design burden and likely improve adoption. Second, future evaluations of teaching competences should rely primarily on post-lecture student feedback instruments, i.e., a standardized survey for each lecture as the overall course, supplemented by organizer assessments. This would reduce the evaluator bias inherent in the current design and provide a more direct measure of the student experience. Third, the framework should be applied and assessed in other practice-oriented lecture series, particularly in different disciplines and institutional contexts, to evaluate generalizability. The operative artifacts provided in this work, including the rating criteria, action item templates, and onboarding protocol, are designed to support such transfer without requiring pedagogical expertise from organizers. Fourth, whether a topic-specific written exam remains the most appropriate assessment instrument for a transdisciplinary lecture series is an open question. Cross-thematic problem scenarios or integrative formats such as project work or learning portfolios may be used to assess the integrative understanding that the series aims to develop. Exploring such formats, and their feasibility within the module structure and credit requirements, is a productive direction for subsequent iterations.

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Declaration of Interest

The authors declare no conflict of interest.

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