Report WP5-A3

Evolving Textbook in engineering education

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Result
This deliverable is part of the Erasmus+ project *TET – The Evolving Textbook* (2022-1-SI01-KA220-HED-000088975), which reimagines the textbook as a digital, adaptive, and interactive tool to enhance student engagement and support innovative teaching in higher education. Within Work Package 5 on dissemination and impact, this report (WP5-A3) focuses on the use of the evolving textbook in engineering education, presenting examples of integration into curricula, insights from teachers and students, and reflections on how the platform can strengthen learning and teaching practices in technical disciplines.

Related to
WP5-A3: An analysis of the evolution of the evolving textbook in selected engineering fields in comparison to traditional textbooks

Statement of originality
This deliverable contains original unpublished work, except where clearly indicated otherwise. Acknowledgement of previously published material and of the work of others has been made through appropriate citation, quotation, or both.

Sustainability and Open Access
In line with the project's dissemination strategy, all outcomes will be made openly available on the project website and through institutional repositories of partner universities. Resources are published under Creative Commons licenses whenever possible, ensuring reusability, adaptation, and further development beyond the project's lifetime.

Note
For anyone interested in having more information about the project, please see the website at: https://tet-erasmus.eu/

Revision Table

• Version	Date	Author	Description
1.0	15/01/2025	Antonio Maffei Fabio Marco Monetti	Issued
2.0	12/03/2025	Antonio Maffei Fabio Marco Monetti	Added Review Table Implemented suggestion from Reviewer D. Stadnicka Populated suggested reading section

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Introduction

his section introduces the *TET – The Evolving Textbook* project and situates the current deliverable (WP5-A3) within its broader objectives. It outlines the project background, the goals of this specific activity, and the scope of the report.

1.1 Project background (*TET – The Evolving Textbook*)

The Erasmus+ project *TET – The Evolving Textbook* (2022-1-SI01-KA220-HED-000088975) addresses the growing need for innovative digital resources in higher education. By reimagining the textbook as an adaptive, interactive, and digital tool, the project seeks to enhance student engagement, foster active learning, and support educators in adopting more flexible and inclusive teaching practices. The evolving textbook acts as both a learning resource and a platform, allowing content to be continuously enriched and adapted to different contexts.

1.2 Objectives of the project

The project aims to:

- strengthen the quality and relevance of higher education by promoting digital innovation,
- improve student engagement through interactive and adaptive learning tools,
- foster innovative teaching methodologies aligned with European digital and educational strategies, and
- support higher education institutions in the transition toward more inclusive and flexible digital learning environments.

1.3 Scope and purpose of the deliverable (WP5-A3)

The deliverable aims to:

- document how the evolving textbook has been applied within engineering education,
- illustrate the integration of digital, adaptive, and interactive materials into technical curricula,
- capture experiences and feedback from educators and students using the platform, and
- identify opportunities and challenges for further adoption in engineering and related disciplines.

This report corresponds to Deliverable WP5-A3 within Work Package 5 on dissemination, exploitation, and impact. Its main purpose is to present the evolving textbook in the context of engineering education, describing the courses developed on the TET platform, their pedagogical and technical integration, and the lessons learned from their use. It also highlights how these experiences contribute to improving teaching and learning practices and to promoting the broader dissemination of the project outcomes.

Methodology

This section describes the methods used to analyse the use of the evolving textbook in engineering education. It outlines how courses were selected, the sources of data considered, and the framework used to evaluate both pedagogical and technical integration.

2.1 Selection of Courses and Contexts

The courses included in this deliverable were selected from those developed and published on the TET platform during the project. Priority was given to modules directly related to engineering education, reflecting the disciplinary focus of the consortium partners. These span across different domains, including advanced manufacturing technologies, assembly methods, software engineering, automation, and quality inspection.

The selection process also aimed to capture diversity. Courses differ in scope, ranging from highly specialised technical modules (e.g. *Advanced Assembly Technologies*, *Servomotor Control via Ethernet*) to broader subjects with cross-cutting value for engineering education (e.g. *Lean Manufacturing*, *Optimization of Production Processes*). By analysing this variety, the deliverable provides insights not only into the potential of the evolving textbook within specific technical domains but also into its flexibility as a general tool for teaching and learning in engineering.

2.2 Data collection Methods

The information presented in this deliverable draws on multiple complementary sources. Course structures and content were first reviewed as available on the TET platform, providing a baseline for analysis. Educators involved in the creation of these modules contributed feedback on their experience with content design, pedagogical choices, and technical integration. This was complemented by learner perspectives collected through structured surveys and informal interviews conducted during pilot activities, focusing on usability, perceived value, and engagement with the platform.

In parallel, usage data from the platform was consulted to provide a quantitative dimension to the analysis. Indicators such as login frequency, duration of study sessions, and completion rates of activities offered a more objective perspective on learner engagement. The combination of self-reported feedback and system-generated analytics ensures a balanced evaluation of how the evolving textbook is being used in practice.

2.3 Evaluation Framework

The evaluation framework was designed to connect pedagogical objectives with digital implementation, ensuring that the analysis reflects both educational quality and technical feasibility. It is structured around four key dimensions:

- **Pedagogical alignment**: examining whether the design of each course follows constructive alignment principles, i.e. ensuring coherence between intended learning outcomes, teaching

and learning activities, and assessment methods. This dimension also considers how interactive features of the TET platform support active learning.
- **Digital integration**: analysing how adaptive and interactive functionalities are embedded into the course design. This includes the use of multimedia content, quizzes, simulations, and collaborative activities, as well as how the evolving textbook complements existing learning management systems (LMS).
- **Learner engagement**: assessing how students interact with the platform, both quantitatively (e.g. activity tracking, usage frequency) and qualitatively (e.g. feedback on usability, motivation, and learning effectiveness).
- **Sustainability and scalability**: considering whether the developed courses can be maintained over time, reused by other educators, and adapted for different contexts or disciplines. This dimension reflects the broader ambition of the project to provide transferable and sustainable models for digital education.

Together, these dimensions create a comprehensive framework that guides the analysis presented in the following sections of the report.

2.4 Limitation of the approach

The evaluation is based on pilot implementations and early data. Variations in institutional context, course design, and student groups may influence outcomes. As such, findings should be interpreted as indicative rather than definitive, pointing to trends and lessons learned rather than final results..

Integration of the Evolving Textbook in Engineering Education

This section examines how the evolving textbook has been applied in engineering education. It highlights the courses developed on the TET platform, how they align with pedagogical and technical principles, and how their modular design as independent educational units supports flexibility, transferability, and cross-institutional integration.

3.1 Pedagogical Alignment with Engineering Curricula

The courses developed within the TET platform are designed as **independent educational units**, each providing a *self-contained block of learning* for students. This approach ensures that every module—whether on *Advanced Assembly Technologies*, *Additive Manufacturing*, or *Software Testing*—can stand alone as a complete learning experience, including defined objectives, instructional materials, and activities for assessment.

By being self-contained, these units can be seamlessly integrated into different engineering curricula, regardless of the institutional context. This allows teachers to adopt single modules as complements to their courses or to combine multiple units into larger, coherent learning paths. The constructive alignment of outcomes, activities, and assessments ensures that the modules contribute directly to skill development in technical disciplines while maintaining portability across universities.

3.2 Indicators and metrics tracked (engagement, frequency, types of activity)

The evolving textbook is designed to integrate seamlessly into a wide range of digital and physical learning environments. Its structure as **independent, self-contained units** means that content can be deployed in multiple teaching contexts without requiring significant modification. This makes it especially valuable in engineering education, where curricula often vary between institutions and courses are delivered in different formats.

From a technical standpoint, the platform supports embedding multimedia content, interactive exercises, and assessment elements directly into each unit. This flexibility allows educators to use the units as:

- **Standalone resources**, functioning as complete short courses that students can access independently;
- **Supplementary material**, enriching traditional lecture-based courses with interactive content and adaptive learning tools;
- **Integrated modules**, directly embedded into Learning Management Systems (LMS) used at partner institutions, ensuring compatibility with existing infrastructures.

Examples from the developed content demonstrate this flexibility. *Lean Manufacturing* has been adopted as a compact unit for supplementary training, while *Optimization of Production Processes* has been integrated into longer modules as part of a larger course sequence. Similarly, *Software Testing – Practical Issues* shows how platform content can directly support practice-oriented, applied exercises in computer engineering.

Another important technical feature is the platform's adaptability. The evolving textbook allows for continuous updating of content, meaning that educators can add new case studies, adjust examples to reflect emerging technologies, and refine exercises based on student performance data. This adaptability is crucial for engineering subjects, which evolve rapidly with industrial and technological advancements. The system's integration with usage tracking also ensures that educators can monitor how students engage with content, closing the feedback loop between teaching, learning, and continuous improvement.

3.3 Integration with the TET platform

The role of teachers in the evolving textbook is twofold: **content development** and **pedagogical facilitation**.

On the development side, educators are responsible for translating their expertise in technical subjects into modular, self-contained learning units. This requires rethinking traditional course structures: instead of designing long, linear courses, teachers break down material into compact, coherent modules that each contain objectives, content, and assessment. This approach makes the content portable and reusable by colleagues in other institutions, effectively promoting cross-institutional collaboration.

As facilitators, teachers guide students in how to engage with the evolving textbook. They contextualise the modules within local curricula, explain how each unit connects to broader learning objectives, and support students in navigating the interactive features. Tutors and assistants often complement this role, monitoring student progress on the platform, answering questions, and providing feedback.

Importantly, teachers also act as **curators of content pathways**. Since the platform's modular structure allows units to be combined flexibly, educators can create customised learning trajectories tailored to the needs of specific student groups. For example, a teacher might combine *Basics of Machine Vision* with *Vision Inspection Systems for Manufacturing Automation* to build a progressive sequence, or integrate *Servomotor Control via Ethernet* into a robotics-related course.

The facilitator role extends to fostering collaborative learning. By leveraging interactive exercises and adaptive features, teachers can encourage teamwork, problem-solving, and applied practice within the digital environment. This aligns with broader pedagogical trends in engineering education, where active learning and real-world problem-solving are increasingly prioritised.

Finally, the modular and transferable nature of the evolving textbook reduces the barriers for educators at different institutions to share and reuse materials. A unit developed at one university can be adopted with minimal adaptation by another, strengthening collaboration across the consortium and supporting the creation of a European community of practice in digital engineering education.

3.4 Student Engagement and Perceptions

For students, the modular, self-contained format translates into clear, focused blocks of learning that can be approached step by step. This structure helps them concentrate on specific technical concepts without being overwhelmed by overly broad or fragmented resources.

Feedback from pilot activities indicated that learners appreciated the clarity of scope within each unit and the possibility to combine units across subjects. For example, students could move from *Basics of Machine Vision* to *Vision Inspection Systems for Manufacturing Automation* in a progressive learning path, while still experiencing each as a complete and independent learning block. This flexibility enhances both engagement and knowledge retention, while also supporting mobility between institutions, since students can transfer completed modules into different academic contexts.

3.5 Benefits of Modular, Self-Contained Units

A defining feature of the evolving textbook is its design as a set of **independent, self-contained educational units**. Each unit constitutes a complete block of learning, with clearly defined objectives, instructional content, and assessment components. This modularity provides several benefits for different stakeholders in engineering education.

- **For students**, the modular format offers clarity and flexibility. Learners can approach each unit as a manageable learning task, building confidence and knowledge step by step. Since each unit is self-contained, students can focus on mastering one topic at a time and then combine units to create a broader learning pathway. This approach also enhances mobility, as students can carry completed units across institutions or programs.

- **For educators**, modularity simplifies the integration of new content into existing courses. Teachers can adopt single units to complement their courses or combine several modules to build a customised sequence. Because the content is portable and follows constructive alignment principles, it can be reused across different teaching contexts with minimal adaptation. This also promotes collaboration among educators, who can share and exchange units across institutions.

- **For institutions**, modular units provide flexibility in curriculum design and support alignment with broader European trends. In particular, the structure of the evolving textbook resonates with the **EU's micro-credential framework**, which promotes the recognition of smaller, well-defined learning achievements that can be accumulated and transferred across educational contexts. Each self-contained unit on the TET platform can be framed as a potential micro-credential, making it easier to certify student learning outcomes and integrate them into lifelong learning strategies.

The connection with micro-credentials is especially valuable in engineering education, where students and professionals need to continuously update their knowledge to keep pace with technological change. By designing learning in modular blocks, the evolving textbook provides not only flexibility within higher education but also a pathway toward professional upskilling and reskilling in line with European policies on education and employment.

In summary, the modular and self-contained design of the evolving textbook supports **scalability, transferability, and formal recognition of learning**. It strengthens the pedagogical effectiveness of engineering education while simultaneously aligning with the EU vision for future-proof, flexible, and inclusive higher education.

Case studies and Examples

This section presents concrete examples of how the evolving textbook has been applied in engineering education. The selected cases illustrate different subject areas—manufacturing, automation, and software engineering—and show how the modular, self-contained design of the units supports diverse pedagogical and technical objectives. A full list of the developped unit is available in Annex I.

4.1 Additive Manufacturing

The *Additive Manufacturing* unit addresses one of the most dynamic areas of modern engineering. Designed as a standalone block, it introduces students to the principles of 3D printing technologies, materials, and design constraints. The course integrates textual explanations with multimedia content, including diagrams and video demonstrations of printing processes.

- **Pedagogical integration:** The unit was designed following constructive alignment principles, with outcomes such as *understanding additive manufacturing processes* and *evaluating their applicability in different industrial contexts*. Activities include short quizzes and scenario-based exercises where students assess the feasibility of applying additive manufacturing in specific design cases.
- **Technical use of the platform:** The evolving textbook enables easy updates to reflect fast-changing industrial practices. Case studies on new materials and hybrid manufacturing methods can be added without redesigning the entire unit.
- **Lessons learned:** Students appreciated the combination of conceptual explanations and applied case studies. The modular design made it possible to integrate the unit into broader manufacturing courses, while also allowing students to engage with it independently as a micro-credential-like block.

4.2 Lean Manufacturing

The *Lean Manufacturing* unit focuses on principles and methods for improving efficiency in production systems. It was created as a concise learning block that could serve as supplementary material for production engineering courses or as a short training resource for industry-oriented learners.

- **Pedagogical integration:** The unit introduces key lean concepts such as waste elimination, value stream mapping, and continuous improvement. Learning outcomes emphasize both conceptual understanding and the ability to apply lean tools to practical scenarios. Interactive exercises guide students in identifying waste in process examples.
- **Technical use of the platform:** The evolving textbook's adaptive features allow for branching exercises, where students' answers guide them to different feedback pathways. This supports an active, problem-based approach rather than passive reading.
- **Lessons learned:** Teachers highlighted the ease of embedding this unit into courses on production management or operations. Students valued the clarity of scope, noting that the unit helped them consolidate key concepts quickly before applying them in group projects.

4.3 Vision Inspection Systems for Manufacturing Automation

This unit addresses advanced inspection technologies used in automated production environments. It is a highly technical subject that benefits from the multimedia capabilities of the evolving textbook.

- **Pedagogical integration:** The unit sets out clear objectives, including the ability to *explain the principles of machine vision* and *evaluate the applicability of vision systems in automation*. Content is supported by diagrams, images of vision system setups, and examples from industry.

- **Technical use of the platform:** Students engage with interactive diagrams and case-based exercises where they analyse inspection scenarios. The unit's modularity makes it possible to connect it seamlessly with related content such as *Basics of Machine Vision*.
- **Lessons learned:** Students reported that visual resources were particularly helpful in clarifying a complex subject. Teachers found that the modular design allowed them to use the unit as a focused introduction to vision systems before expanding into more advanced, hands-on laboratory work.

4.4 Software Testing – Practical Issues

The *Software Testing – Practical Issues* unit exemplifies the application of the evolving textbook in computer and software engineering. It provides structured, practice-oriented content that students can use to develop both theoretical knowledge and applied skills.

- **Pedagogical integration:** The unit covers different testing techniques, each accompanied by practical examples. Outcomes include the ability to *apply testing methods* and *evaluate their effectiveness in specific contexts*. Quizzes and step-by-step exercises reinforce the learning.
- **Technical use of the platform:** The modular design allows this unit to function as an independent training block for students in software engineering courses, or as supplementary material for those in interdisciplinary programs. The evolving textbook makes it possible to incorporate code snippets, diagrams, and links to external resources.
- **Lessons learned:** Students found the structured, example-driven approach effective for self-paced study. Educators emphasised that the unit could be integrated flexibly into both introductory and advanced software engineering courses, depending on the depth of application.

4.5 Advanced Assembly Technologies

The *Advanced Assembly Technologies* unit addresses modern methods and tools used in automated assembly processes. It was designed as a self-contained unit that combines theoretical concepts with applied industrial examples.

- **Pedagogical integration:** Learning outcomes include the ability to *identify different assembly techniques*, *evaluate their efficiency and limitations*, and *apply criteria for selecting assembly solutions*. Students engage in scenario-based tasks where they compare traditional and automated assembly methods.
- **Technical use of the platform:** The evolving textbook enables the integration of images, animations, and case studies from industrial practice. Interactive exercises simulate decision-making situations, where students must choose assembly strategies based on cost, precision, and productivity requirements.
- **Lessons learned:** Students valued the clear structure of the unit and its focus on decision-making skills. Teachers appreciated that the modular format allowed them to use the unit as

either an introduction to assembly methods or as supplementary material in advanced automation courses.

4.6 Basics of Machine Vision

The *Basics of Machine Vision* unit introduces foundational concepts for understanding and applying vision systems in manufacturing. It provides a stepping stone toward more advanced units, such as *Vision Inspection Systems for Manufacturing Automation*.

- **Pedagogical integration:** The unit focuses on fundamental learning outcomes such as *describing the components of a vision system*, *understanding image processing techniques*, and *explaining key applications*. Activities include guided reading, quizzes, and examples drawn from industrial contexts.
- **Technical use of the platform:** As a modular, self-contained block, the unit can function independently for students new to the subject or be linked with the more advanced vision system modules. The platform supports the use of images and diagrams that are essential for visual learning.
- **Lessons learned:** Students noted that the unit helped them grasp technical vocabulary and basic principles before engaging in more complex exercises. Teachers reported that its standalone format made it easy to incorporate into a variety of curricula, from introductory automation courses to specialised modules in quality inspection.

4.7 Comparison Across Contexts

Dimension	Findings Across Case Studies
Self-contained learning blocks	All six units (*Additive Manufacturing, Lean Manufacturing, Vision Inspection Systems, Software Testing, Advanced Assembly Technologies, Basics of Machine Vision*) are structured as independent modules with objectives, content, and assessment. This enables reuse and portability across institutions.
Relevance to engineering practice	Units link theory with real-world applications (e.g. decision-making in assembly, industry cases in additive manufacturing, applied exercises in software testing). This ensures both conceptual learning and applied competence.
Flexibility of use	Modules can be delivered as stand-alone short courses, supplementary training resources, or integrated sequences (e.g. *Basics of Machine Vision* + *Vision Inspection Systems*).
Technical adaptability	The evolving textbook supports multimedia, interactive exercises, adaptive pathways, and continuous updates, ensuring content remains engaging and up to date with technological change.

Dimension	Findings Across Case Studies
Scalability and recognition	The modular design aligns with the EU micro-credential framework, making it possible to recognise smaller, well-defined learning achievements and combine them into larger learning paths.

Results and Discussion

This section synthesises the findings from the case studies and evaluates how the evolving textbook has contributed to engineering education. The analysis considers pedagogical, technical, and institutional dimensions, as well as alignment with broader European educational strategies.

5.1 Pedagogical Impact

The evolving textbook demonstrated clear benefits in promoting constructive alignment within engineering education. By structuring content into independent units, educators were able to define precise learning outcomes and directly connect them to learning activities and assessments. This coherence strengthened the educational design and made it easier for students to understand what was expected of them.

The case studies also show that the interactive features of the platform encouraged **active learning**. Instead of passively consuming content, students engaged with quizzes, branching exercises, and multimedia resources that required application of knowledge. For example, the *Lean Manufacturing* unit guided students through identifying waste in simulated processes, while the *Software Testing* unit required them to apply methods to practical scenarios. These experiences reflect a shift from knowledge transmission to knowledge application, which is central to effective engineering education.

5.2 Technical Integration and Flexibility

The evolving textbook proved to be highly adaptable across a range of technical and institutional settings. Its modular design allowed each unit to function independently, requiring minimal contextualisation for integration into existing courses. This was particularly valuable for partner institutions with diverse curricula and digital infrastructures.

Educators were able to adopt units in three primary ways (see Figure 1):

1. **As stand-alone modules** – for example, *Lean Manufacturing* was used as a compact course on its own, aimed at both students and industry professionals seeking targeted training.
2. **As supplementary resources** – units such as *Software Testing – Practical Issues* complemented larger computer engineering courses by offering focused, practice-oriented content.

3. **As building blocks for sequences** – *Basics of Machine Vision* and *Vision Inspection Systems* were combined into a progressive pathway, illustrating how smaller blocks can be assembled into larger learning structures.

The platform's technical adaptability also extended to **continuous updating**. Since engineering knowledge evolves quickly, units could be refreshed with new case studies, diagrams, or industry examples without redesigning the entire course. For example, the *Additive Manufacturing* unit was updated with emerging methods like hybrid printing.

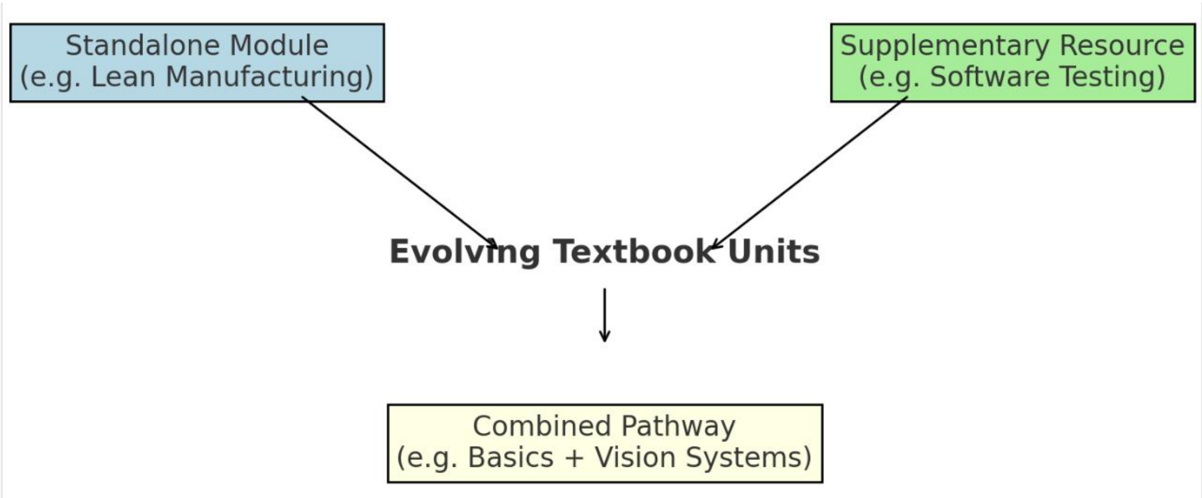

FIGURE 1 THE THREE MODES OF INTEGRATION (STAND-ALONE, SUPPLEMENTARY, COMBINED)

5.3 Student Engagement and Learning Experience

Students responded positively to the evolving textbook's **self-contained and interactive design**. The clear learning objectives and focused content blocks helped them manage complexity, while the interactive activities increased motivation. For instance, quizzes in *Lean Manufacturing* allowed learners to test their ability to spot inefficiencies in production scenarios, while branching exercises in *Software Testing* provided instant feedback on applied problem-solving.

A significant benefit reported by students was the **flexibility to engage at their own pace**. Units could be studied independently, enabling learners to revisit difficult topics or advance more quickly through familiar material. This flexibility proved valuable not only for traditional students but also for working professionals or part-time learners, aligning with the European vision of lifelong learning.

Feedback indicated that the modular design also supported **transferable learning pathways**. Students who completed one unit, such as *Basics of Machine Vision*, felt more confident moving on to advanced topics, showing how the evolving textbook supports stepwise progression.

5.4 Institutional and Strategic Relevance

For higher education institutions, the evolving textbook represents an innovative response to the challenges of digital transformation in teaching. Its modular units enable institutions to experiment with new pedagogical approaches without overhauling entire programs. This lowers the barrier for adopting digital innovation and allows for gradual, scalable integration.

The **cross-institutional transferability** of the units is another strategic advantage. A unit developed at one partner university could be reused by others with minimal adaptation, promoting collaboration and reducing duplication of effort. This aligns with European objectives of fostering shared digital learning resources and building networks of excellence across universities.

Most importantly, the design of the units directly resonates with the **EU micro-credential framework**. See Figure 2. Each unit, as a complete block with outcomes and assessments, could be certified and recognised as a micro-credential. This means institutions could formally acknowledge smaller learning achievements, supporting flexible curricula and offering students tangible proof of skills acquisition. For engineering education, this opens pathways for professional upskilling and reskilling in fast-changing industries.

FIGURE 2 ALIGNMENT WITH EU MICRO-CREDENTIAL

5.5 Challenges and Areas for Improvement

While the evolving textbook showed strong potential, several challenges emerged:

- **Educator workload:** Developing modular units required teachers to rethink their approach, breaking long courses into smaller, self-contained blocks. This was seen as time-intensive at the start, although easier to manage once templates and examples became available.
- **Variation in digital readiness:** Institutions differed in their technical infrastructure and support. Some could embed units directly into LMS systems, while others faced limitations, affecting the smoothness of adoption.
- **Digital literacy among students:** While many students welcomed interactivity, some needed additional guidance in using the platform effectively. Orientation sessions or short tutorials were suggested as useful additions.
- **Adaptive learning features:** Although the platform included interactivity, there is room to strengthen adaptive functions that personalise learning pathways based on student performance. More sophisticated analytics could further guide learners and educators.

These challenges underline the importance of **ongoing support, technical improvements, and community building** around the evolving textbook. With further development, the platform could become a leading model for modular, adaptive, and credentialised learning in engineering education.

Conclusions and Recommendations

The implementation of the evolving textbook in engineering education demonstrates the potential of modular, digital, and interactive learning resources to enhance teaching and learning. The analysis of six case studies showed that the platform effectively supports constructive alignment, promotes active engagement, and offers institutions a flexible tool to innovate their curricula.

The **main conclusions** can be summarised as follows:

- The modular, **self-contained unit design** enables seamless adoption across institutions and aligns naturally with the EU micro-credential framework.
- Students benefit from **clarity, flexibility, and interactivity**, making complex technical subjects more approachable and motivating.
- Educators gain a scalable resource for course innovation and cross-institutional collaboration, though the initial workload for redesign is significant.
- Institutions can use the evolving textbook as a **strategic lever for digital transformation**, supporting flexible curricula and lifelong learning.

6.1 Recommendations for Educators

- Break down existing courses into **modular learning units** that can function independently.
- Use the platform's interactivity to promote **applied, problem-solving activities** rather than content transmission.
- Share and reuse units across institutions to foster a **community of practice**.

6.2 Recommendations for Institutions

- Recognise evolving textbook units as **building blocks for micro-credentials**, supporting flexible certification and student mobility.
- Provide **technical and pedagogical support** for educators developing modular content, reducing the initial workload barrier.
- Integrate the platform into existing **LMS environments** to ensure smooth adoption.

6.3 Recommendations for Policymakers and Stakeholders

- Align policies with the potential of modular digital learning, recognising them within the **European micro-credential framework**.
- Encourage cross-institutional collaboration and resource sharing, ensuring that innovative units reach a wider audience.
- Support investments in adaptive technologies to enhance the platform's potential for **personalised learning pathways**.

In conclusion, the evolving textbook offers a **scalable, flexible, and future-oriented model** for engineering education. By embracing modularity, interactivity, and micro-credentials, it not only improves student learning experiences but also positions higher education to respond effectively to the challenges of digitalisation and rapidly evolving industry needs.

Key Messages

- **Modularity matters:** Self-contained units make learning more flexible, portable, and aligned with the EU micro-credential vision.
- **Students benefit:** Clear objectives, interactive activities, and stepwise progression improve motivation and understanding.
- **Educators gain tools:** The evolving textbook supports constructive alignment and cross-institutional sharing, though support is needed to reduce workload.
- **Institutions advance:** Adoption strengthens digital transformation strategies, enabling scalable and transferable innovation in curricula.

Suggested Readings

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Annexes

Annex I: List of engineering courses developed on the TET platform

Course / Unit Title	Institution	Domain / Focus Area	Short Description
Mechatronic Actuators	University of Ljubljana	Mechatronics, Electrical Drives and Control	Overview of mechatronic actuator types and principles, including electromagnetic drives, DC, AC, and stepper motors, mechanical transmissions, and sensors for motion control.
Signals and Systems	University of Ljubljana	Control Engineering, Systems Theory	Introduction to the state-space approach for modeling and design of linear control systems, including system dynamics, state equations, and feedback control laws.
Basics of Machine Vision	University of Ljubljana	Machine Vision, Image Processing	Introduction to image processing and machine vision, covering basic algorithms, image manipulation, morphological operations, and BLOB analysis.

Logic Systems	University of Ljubljana	Control and Automation, Logic Systems	Fundamentals of propositional, predicate, and fuzzy logic applied to analysis and control of automated systems.
Data Analysis	Rzeszow University of Technology	Data Analytics, Information Systems	Introduction to data analysis techniques, including dashboard creation, predictive modeling, model evaluation, and social network analysis applications.
Simulation Modelling	Rzeszow University of Technology	System Dynamics, Manufacturing Systems	Introduction to system dynamics modelling with applications in manufacturing, covering model development and system components.
Software Engineering: System Analysis in Practice	Rzeszow University of Technology	Software Engineering, Systems Analysis	Practical introduction to system analysis and communication processes in software development, illustrated through institutional case examples.
Software Testing: Practical Issues	Rzeszow University of Technology	Software Engineering, Quality Assurance	Overview of software testing methods, including equivalence class, statement, branch, and decision testing, with emphasis on practical application.
Lean Manufacturing	Rzeszow University of Technology	Production Engineering, Process Optimization	Introduction to lean principles and tools, including 5S, value stream mapping, SMED, TPM, continuous improvement, and the Toyota Production System.
Planning and Control	Royal Institute of Technology Stockholm	Production Engineering, Operations Management	Fundamentals of production planning and control, including aggregate planning, inventory management, MRP, scheduling, lean production, and value stream mapping with practical exercises and simulations.
Fundamental Assembly Technologies	Royal Institute of Technology Stockholm	Manufacturing Engineering, Assembly Systems	Introduction to manual and automated assembly processes, including line balancing, design for assembly, and case studies from diverse industries with practical exercises and group projects.
Advanced Assembly Technologies	Royal Institute of Technology Stockholm	Advanced Manufacturing, Automation	Exploration of automated assembly systems, robotics, and hardware for automation, including industrial case

			studies, cost evaluation exercises, and project-based learning on digitalised manufacturing.
Manufacturing Processes	University of Pisa	Manufacturing Engineering, Machining and Forming	Overview of conventional and advanced manufacturing processes, including machining, casting, forming, welding, and inspection, with multimedia materials and practical case examples.
Vision Inspection Systems for Manufacturing Automation	University of Pisa	Machine Vision, Automation	Introduction to vision inspection systems with practical exercises in Python programming and industrial case studies on automated quality control.
Optimization of Production Processes	University of Pisa	Industrial Engineering, Production Optimization	Study of optimization methods for production systems, combining IT/OT integration, security aspects, and metaheuristic approaches in industrial operations.
Additive Manufacturing	University of Pisa	Advanced Manufacturing, 3D Printing	Introduction to additive manufacturing principles and 3D CAD modeling, covering processes, materials, and design considerations for modern production.

Annex II: Template for describing educational units.

The template for describing courses (educational units) — including the Intended Learning Outcomes (ILO), Teaching and Learning Activities (TLA), and Assessment Tasks (AT) — was developed within Work Package 3, Activity **WP3-A2: Tools for the Ontology Schema Implementation**.

It provides a standardized structure for documenting the pedagogical and technical components of each unit and ensures consistency across partner institutions.

The template is publicly available as the TET project result at:

https://tet-erasmus.eu/results/WP3_EduMaterialDataBase_Template.pdf

Annex III: Example of student/teacher feedback questions.

This annex provides examples of questions used to collect qualitative feedback from students and teachers participating in pilot implementations of the *Evolving Textbook* in engineering education.

The questions reflect the project's focus on pedagogical alignment, interactivity, technical usability, and user experience on the TET platform.

Student Feedback Questions

- How clearly were the learning objectives of each module communicated at the beginning of the unit?
- To what extent did the interactive elements (videos, quizzes, or exercises) help you understand the course content?
- How easy was it to navigate through the course materials on the TET platform?
- Did the modular structure (independent learning units) help you organize your study more effectively?
- How engaging did you find the multimedia and visual elements in the course?
- Were the self-assessment and feedback features useful in tracking your progress?
- How relevant were the examples and case studies to real engineering practice?
- Did you experience any technical difficulties when accessing the materials or interactive content?
- How would you compare learning with the Evolving Textbook to using a traditional printed textbook?
- Would you like to see other engineering courses delivered in this digital, modular format?

Teacher Feedback Questions

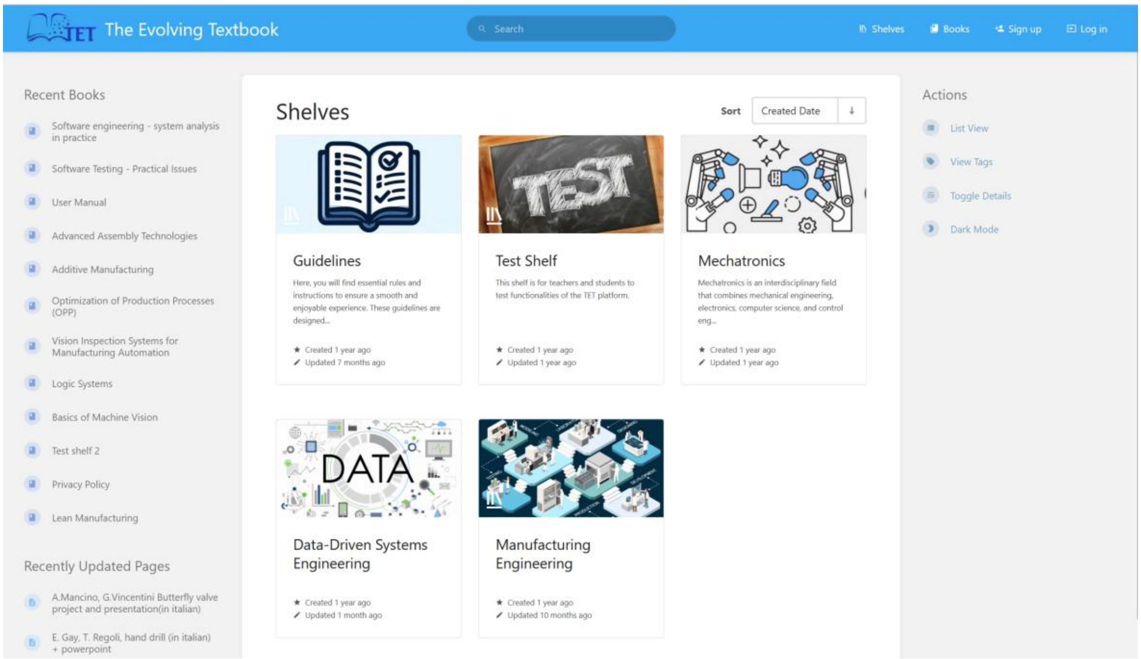
- How easy was it to adapt your existing teaching materials into modular units on the TET platform?
- To what extent did the Evolving Textbook support constructive alignment between learning outcomes, activities, and assessments?
- How intuitive did you find the authoring and editing tools for creating or updating course content?
- Did the platform's analytics or usage data help you monitor student engagement and learning progress?
- How did students respond to the interactive and self-paced learning approach compared to traditional methods?
- Were the modular units easily reusable or adaptable for other courses or contexts?
- What challenges did you encounter in integrating the platform with your institution's learning management system?
- Did the modular format reduce or increase your overall workload in course preparation and delivery?
- In your opinion, does the Evolving Textbook approach support the development of micro-credentials or smaller certified learning units?
- What improvements would you recommend to enhance the pedagogical or technical aspects of the platform?

Annex IV: Platform screenshots (visual evidence).

This annex presents visual examples from the **TET platform** illustrating how courses are structured, how interactive content is displayed, and how usage data can be monitored. The screenshots provide evidence of the platform's functionality and user interface as used during pilot implementations in engineering education.

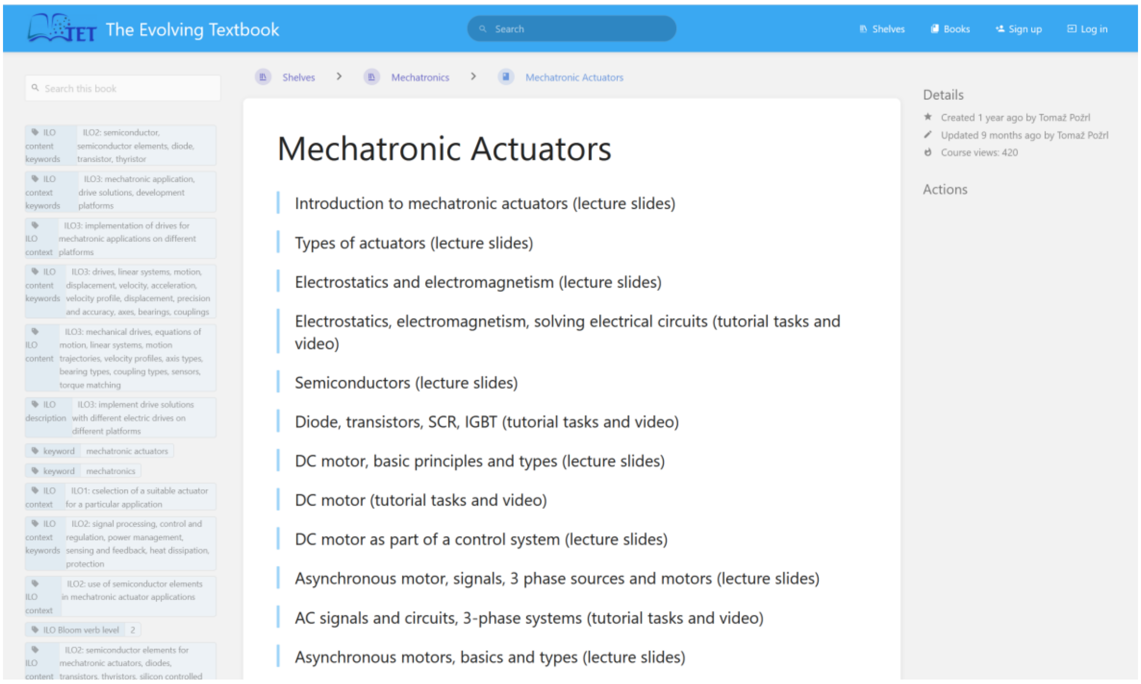
TET platform homepage

Illustrates the main entry page of the Evolving Textbook platform, showing the navigation structure, featured courses, and access options for students and teachers.



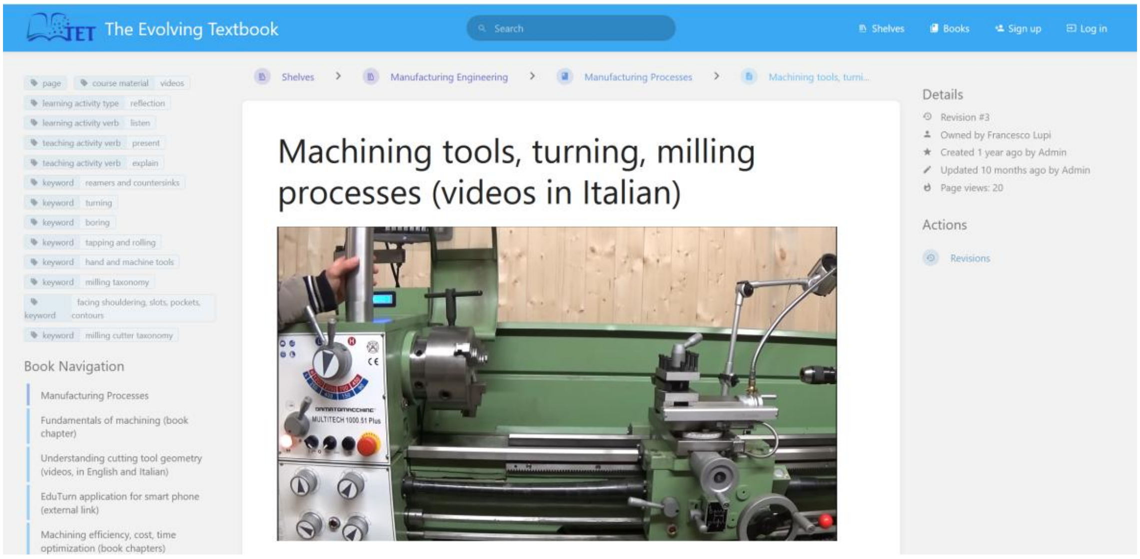
Mechatronic Actuators course main page

Shows the organization of an individual course on the platform, including modular structure, list of lecture materials, tutorial tasks, and embedded multimedia resources.



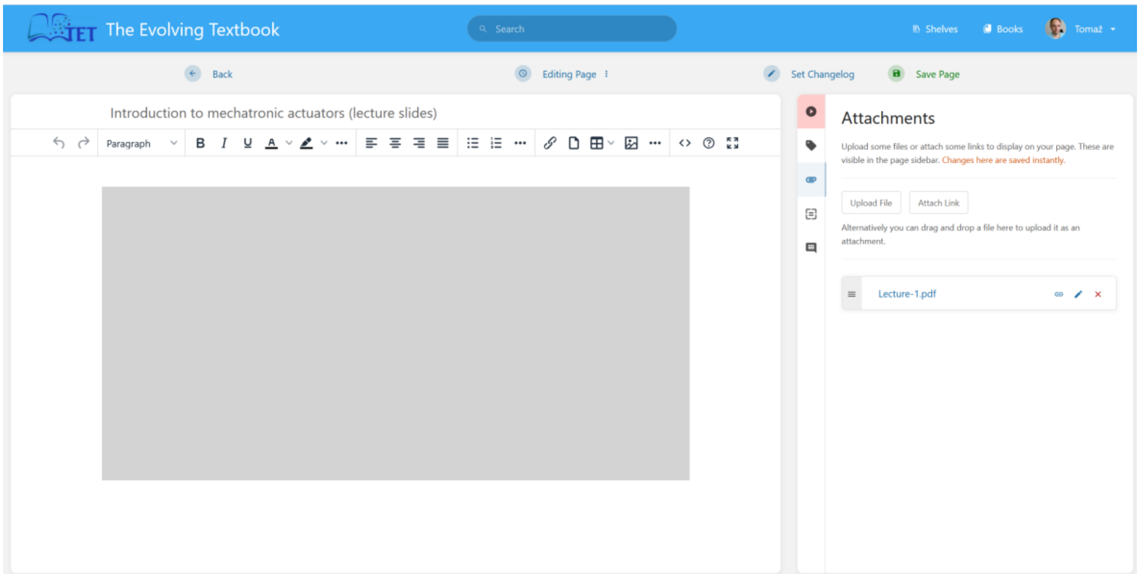
Embedded video in course on Manufacturing Processes

Demonstrates integration of multimedia content within a course page, supporting interactive and visually rich learning experiences.



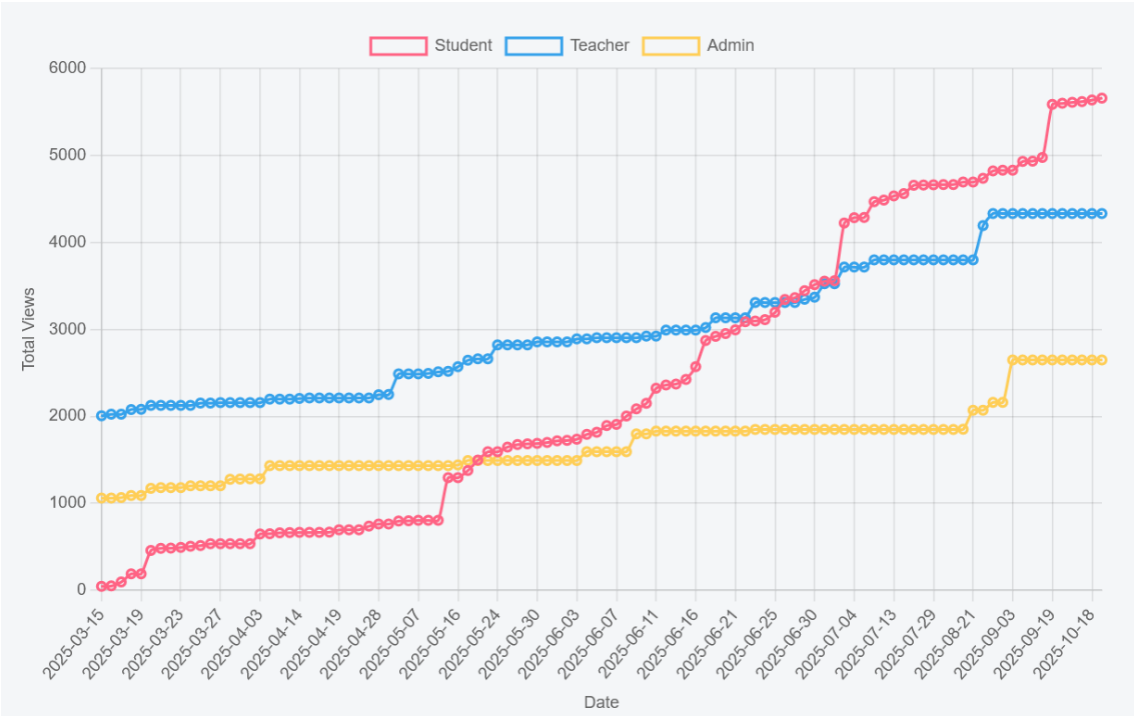
Teacher edit interface

Displays the backend view available to educators, showing options for creating, editing, and organizing units, and highlighting the modular and reusable structure of educational content.



Views over time by user role

Example of analytics functionality showing aggregated view statistics for students, teachers, and administrators over a selected period, used to monitor engagement and platform usage.



Lead Partner

Partners