# **The Evolving Textbook**

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# Abstract

The Erasmus+ project, "The Evolving Textbook" (TET), aims to revolutionize higher education by developing a digital, adaptive textbook platform that addresses the needs of both teachers and learners. Traditional textbooks, often outdated and limited by content and cost constraints, fail to keep pace with rapidly advancing fields, particularly in engineering disciplines. The TET platform, designed collaboratively by multiple institutions, allows for the continuous evolution of textbook content, integrating textual, graphical, video, and other multimedia elements created by both teachers and learners. The platform supports dynamic content updates, personalized learning experiences, and active learner contributions. By leveraging advanced ICT tools, the TET platform enhances educational flexibility and responsiveness, promoting interconnected higher education systems. This paper presents the framework and objectives of the TET project, highlighting the benefits for educational stakeholders and the innovative approach to textbook evolution.

# 1 Introduction

To meet the demands of today's knowledge economy, education must move beyond the industrial age approach of treating all learners the same and adopt a learner-centered model suitable for the information age [1]. Industry is known to evolve in stages, with the latest commonly referred to as Industry 5.0. Similarly, education is evolving. Although less familiar to engineers, Education 1.0, Education 2.0, and Education 3.0 have also been introduced [2], with even higher numbers being used in some cases [3]. Education 1.0 is based on the three Rs (receiving, responding, and regurgitating), meaning students listen to the teacher, take notes, and complete the same assessments as all other students. Education 2.0 emphasizes interaction between teachers and students. A typical innovation of this stage is the so-called massive open online course (MOOC). This stage is based on the three Cs: communicating, contributing, and collaborating, with everyone working together. Education 3.0 is also based on three Cs: connecting, creating, and constructing. Students have the freedom to shape their learning process according to their needs and goals.

From the students' perspective, the most important part of the learning process is their satisfaction. Student satisfaction with the university experience is a complex and multifaceted phenomenon, with no general consensus on how to best conceptualize and measure it [4]. One aspect of this satisfaction is the availability of proper teaching materials. In a classical teaching setting, this material is prepared by teachers who are typically one generation older than the learners. Approaches that they deem most suitable may often not be appropriate for the younger generation. Also, with the fast development of technology, newer teaching methods are becoming available that the teachers' generation may not be well acquainted with, but younger people use proficiently. Therefore, it is questionable whether teachers alone can prepare the optimal teaching material. One approach to addressing this problem is the so-called teaching material co-creation. The infrastructure for co-creating learning materials involves adopting new features such as the Education 3.0 paradigm [5] and Web 3.0 [6]. To enable learners to take control of their learning needs and actively contribute to their learning processes, educators can partner with students in various reciprocal student-staff partnership (SSP) settings where students can be co-creators, co-producers, curators, or co-deliverers of the curriculum [7].

Through this co-creation process, students' resources, such as time, novel ideas, and feedback, merge with organizational resources to foster experiences and activities that promote interaction and exchange, ultimately leading to improved practice and innovation [8]. An example is the introduction of a co-creation assignment into an undergraduate tax module [9]. It was found that cocreation assignments had a statistically significant impact on academic performance [10]. Additionally, because student contributors provide unique perspectives, greater inclusivity, and diverse approaches to teaching, there are benefits for instructors, student contributors, and student learners [11]. Co-creation is not limited to study material; it can also be applied to curriculum development [12]. The literature on this subject raises the question of whether students are ready for co-creation [13].

It is also noted that co-creation is not only the domain of higher education institutions. Designing a co-creation system for the development of work-process-related learning material in manufacturing is, for example, explained in [14]. of higher education teaching materials involving several universities. This framework emerged from the successful implementation of the Erasmus+ project, "The Evolving Textbook." The ultimate goal of the project is to create an online platform where teaching materials are developed using the co-creation approach described above.

#### 2 Erasmus+ project The Evolving Textbook

Creating such a platform exceeds the capabilities of a single institution. A broader partnership is necessary to cover a wide range of topics and address the varying levels of background knowledge in core areas like mathematics and physics. Additionally, it must consider the differing levels of digital proficiency across Europe. Therefore, the following institutions were selected to form the project partnership:

- University of Ljubljana, Slovenia (UNILJ)
- Royal Institute of Technology, Stockholm, Sweden (KTH)
- University of Pisa, Italy (UNIPI)
- Rzeszow University of Technology (PRZ)

With such an approach we targeted the following horizontal and vertical priorities of the Erasmus+ programme:

- · Horizontal priority: Addressing digital transformation through the development of digital readiness, resilience, and capacity.
- Higher education priority: Stimulating innovative learning and teaching practices.
- Horizontal priority: Inclusion and diversity in all fields of education, training, youth, and sport.

The main idea of the project is the collaborative development of an evolving digital textbook. This platform will feature core information that evolves over time, incorporating textual, graphical, video, and other content created by both teachers and learners. It will support daily educational activities and stimulate innovative teaching and learning practices, , aligning with the principles of the Twin Transition 2.0 by promoting both digital transformation and sustainability in education systems [15].

The platform will offer tools for content creation, structuring, connectivity with other resources, and storage, enabling easy browsing, presentation, and sharing of resources in various educational settings. Learners can provide feedback on content, and a recommender system will suggest relevant materials based on user data.

The platform will support learners with diverse backgrounds and needs. Developed collaboratively with partner institutions, it will promote interconnected higher education systems. Each partner will contribute core content from their curriculum, which will be dynamically integrated and used in upgraded courses. Considering pedagogical, cultural, and environmental differences among

In this paper, we present an approach for the co-creation partners, the platform aims to be a cross-national and cross-cultural teaching and learning tool. It aligns with the national priority of developing digital skills and resources, personalizing educational materials, and involving learners in their creation.

> From a certain point of view, the project can be viewed as a continuation of the previous Erasmus+ projects ICCT and MAESTRO.

The ICCT project, led by UNILJ, addressed the challenges many students face in studying Control Theory. A survey among partner countries revealed that students would greatly benefit from an interactive course that combines traditional textbook information with highly illustrative visuals made possible by advanced software. The ICCT platform offers an advanced interactive course in Control Theory, developed using Python, an open-source programming language, and includes exam questions. Both students and teachers can use or further develop the platform to better suit their needs. However, the platform does not support co-creating content or evolving course materials. The TET project aims to address these additional needs.

The MAESTRO project, led by KTH, focused on integrating contributions in Industry 4.0 and sustainability into industrial engineering programs. It involved developing joint programs, double degrees, summer schools, and exchange packages, allowing students from different institutions to follow joint profiles with one or two semesters abroad, with automatic credit validation. The MAESTRO project aimed to foster partner cooperation through joint programs and other collaborative efforts. This cooperation will be enhanced with the collaborative development and implementation of the evolving textbook platform in the TET project.

The project addresses the needs of teachers and learners in higher education engineering courses. Traditional textbooks are published infrequently due to content and cost constraints, often making them outdated. While some foundational courses like Mathematics or Physics remain stable, most engineering disciplines evolve rapidly. Institutions in the TET project consortium aim to stay current with scientific advancements to remain attractive to students.

Although online education and e-classrooms offer some flexibility, improvements are typically limited to individual efforts by teachers. This project aims to create a platform for an evolving digital textbook that allows rapid content updates by teachers and active feedback and contributions from learners. The platform will personalize materials based on learners' feedback, usage data, preexisting knowledge, and learning abilities, providing a tailored textbook experience.

The target groups we have identified are teachers and learners. Teachers and learners will benefit from the ability to quickly update and adapt textbooks to reflect changes in pedagogical theory and scientific advancements. Advanced tools will enable teachers to monitor the progress and learning abilities of each generation of learners and make rapid adjustments accordingly. The main target

group is learners. The textbook content will be tailored to meet their needs and address potential learning challenges. Learners will receive customized content and have the option to provide feedback. If learners find additional content that could benefit others, they can submit it to the platform, enriching the textbook and ensuring it constantly evolves and improves over time.

The project has been divided into the following four work packages (in addition to the Project Management work package):

- Platform tools analysis
- Core textbook content preparation
- Platform development and deployment
- · Evaluation, dissemination, and impact

The goals of each work package are presented in the following sections.

# 2.1 WP2: Platform tools analysis

The initial phase of the project involves an in-depth examination of online education software solutions suitable for our platform. Each partner provided a description of the educational materials currently in use within their courses and institutions, which was used to establish the fundamental parameters of the TET platform. To account for different pedagogical strategies among the participating institutions, each partner outlined the necessary platform requirements from their perspective. These requirements included local and network infrastructure specifications, support for various programming tools and applications, and preferred programming languages. The selection process also took into account the diverse pedagogical, socio-economic, and cultural backgrounds of learners, as well as their familiarity with contemporary computer tools and applications. By consolidating the inputs from all partners, we conducted a comprehensive analysis to determine which tools met both shared and unique needs, leading to the final selection of the tool(s) for platform development.

# 2.2 WP3: Core textbook content preparation

Traditional Higher Education (HE) textbooks are authored by experienced professors and researchers to present stateof-the-art knowledge in various educational fields. They are designed to be broadly applicable across different education levels and student backgrounds. Due to the significant effort required for their preparation, these textbooks are only published every few years. This delay can render textbooks outdated, especially in rapidly advancing fields. The TET project seeks to develop a digital, evolving textbook platform without restrictions on content type, multimedia, or volume, allowing for continuous updates. This work package involves restructuring core content for selected topics to create a more flexible and dynamic learning experience. A basic content domain structure (ontology) is defined for each topic, linking current and new educational content to enable advanced content presentation and structuring. This ontology is designed to be flexible and expandable as needed.

### 2.3 WP4: Platform development and deployment

The objective of this work package is to develop The Evolving Textbook platform. Utilizing advanced information and communication technologies (ICT), this platform will support the continual evolution of core textbooks. It will assist content creators, teachers, and learners in their daily educational activities by providing tools for content creation, structuring, connectivity with other resources, and storage. The platform will facilitate easy browsing, presentation, and sharing of resources in classrooms, online, or blended learning environments. Learners will be able to provide feedback through ratings, comments, and content recommendations. The key innovation of this platform is its ability to evolve textbooks over time with learner input. The TET platform is designed to be content-independent and transferable to various fields and topics. To our knowledge, no existing educational platform offers such a comprehensive suite of tools for textbook evolution.

# 2.4 WP5: Evaluation, dissemination, and impact

In the last work package, we will evaluate the benefits that the innovative platform developed in this project brings to teachers and learners. This work package will define the collection of all user and content data on the platform. All actions by teachers and learners will be stored in a database for later analysis, which will also include details on all educational materials. To assess the benefits of the TET platform, learners' knowledge and skills will be evaluated through a series of exams before and after using the platform, focusing on factors that influence their studying abilities. The evolution of the textbook will be assessed by comparing TET content with existing textbooks in selected engineering fields, focusing on new material suggested or added by learners and its impact on the overall textbook content. Additionally, this work package includes dissemination activities to generate a wider impact beyond the consortium partners and their HE courses.

# 2.5 Project timeline

Fig. 1 shows a Gantt chart of the project actions: work packages, activities, and international meetings. These meetings are crucial for communication and networking among the project partners and are organized at the beginning of the project (kick-off meeting) and after the successful completion of each work package. Each partner organizes one international meeting. The project is structured into four main work packages, each with specific activities and deliverables. The timeline ensures a logical progression and efficient use of resources throughout the project duration. The sequence of activities and meetings ensures ongoing collaboration and alignment among partners, facilitating the successful implementation of the evolving textbook platform. The timeline also allows for flexibility to accommodate any unforeseen challenges while maintaining a focus on delivering high-quality outcomes.



Figure 1: TET project timeline

### 2.6 Current status of the project

As of now, the consortium has completed the WP2: Platform tools analysis and the WP3: Core textbook content preparation work.

In WP2, the focus was on defining the parameters for an online educational platform, analyzing available ICT tools, and reviewing relevant literature to select suitable tools and technologies for the TET platform. This involved gathering input from all partners about their current teaching practices, preferred tools, and requirements. The results provided a comprehensive set of recommendations and guidelines that shaped the platform's functional requirements, ensuring it supports diverse teaching and learning needs across institutions.

WP3 centered on preparing the core content for the evolving textbook. This included developing an ontology schema to structure content based on learning outcomes, identifying appropriate tools for implementing this schema, and preparing a set of core teaching materials for integration. All partners contributed existing educational content from their fields, described using the newly developed ontology, and conducted cross-evaluations to ensure consistency and usability. The result is a robust foundation of structured content ready for deployment on the TET platform.

The project is now transitioning into the WP4: latform development and deployment. The platform environment has been selected, and the integration of the core textbook content has commenced. A preliminary version of the platform is in development, and a sample of textbook content has already been incorporated. A visual example of this content is provided in 2.

In the coming months, the platform will be put into practical use at UNILJ and UNIPI, allowing for further testing, feedback, and refinement before a broader rollout. This hands-on implementation will enable both students and educators to interact with the platform, providing invaluable insights to inform future updates and developments. By spring next year, we aim to have a functional platform that supports dynamic co-creation and content evolution, aligning with the project's goals to revolutionise higher education through an adaptive and interactive digital textbook platform.

# **3** Conclusion

The "The Evolving Textbook" project represents a significant advancement in higher education, addressing the limitations of traditional textbooks through a digital, evolving platform. By enabling rapid content updates and integrating contributions from both teachers and learners, the TET platform ensures that educational materials remain current and relevant. This collaborative approach not only enhances the learning experience but also fosters a more inclusive and adaptive educational environment. The comprehensive analysis and development process, involving multiple institutions, has resulted in a versatile and scalable platform that can be applied across various fields and educational contexts. The positive impact on



Figure 2: TET platform content

both teaching practices and learner outcomes underscores the potential of the TET platform to transform higher education, making it more responsive to the needs of the modern knowledge economy.

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