E-LEARNING AS AN EXTENSION OF TRADITIONAL TRAINING METHODS FOR DESIGNERS CHANGING CAD/PLM SYSTEMS

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ABSTRACT

The rapid evolution of CAD technologies and their integration with PLM systems often disrupts workflows and frustrates designers, from novices to experts. ARTECH Consulting GmbH tackles this with an innovative training concept designed to help designers adapt efficiently. Combining technical training with human-centred methods, the approach respects individual expertise and learning styles. It features self-paced modules, interactive tutorials, and project-based learning, all tied to real-world challenges. Emphasis is placed on understanding how new CAD/PDM tools impact collaboration, prototyping, and file lifecycle management. The training includes multi-user, multimodal scenarios to foster collaborative design thinking and diverse workflow perspectives. It also addresses psychological and professional hurdles through progressive learning, peer networks, and feedback loops, supporting smoother transitions and sustained motivation. Pedagogically, it focuses on practical exercises with realistic problems to ease learning curves and boost confidence. Early implementations show increased engagement and adaptability among users. By addressing both technical and human factors, this approach supports human-centred teaching and offers a flexible, collaborative learning model for design professionals. Companies adopting new CAD or PLM systems can use this training to effectively support their teams and ease the transition.

Keywords: CAD/PLM, training, E-Learning, blended learning, designers, software transition

1 INTRODUCTION

Designers ─ defined here as individuals with an academic background in mechanical engineering or equivalent qualifications, as well as those with vocational training as technical product designers or certified mechanical designers ─ play a pivotal role in successful product development [1]. Consequently, proficiency in the relevant CAD and PLM tools is essential to their productivity. Employers typically prefer candidates already experienced with the software in use, aiming to ensure immediate effectiveness. While students and apprentices acquire design logic and some software experience during their education, hands-on familiarity with specific tools provides a competitive advantage. However, situations frequently arise in which designers must adapt to unfamiliar software, whether due to hiring decisions, software migrations, or updates to corporate toolsets. In such cases, structured training is not only beneficial, but often necessary to ensure a smooth transition. According to ARTECH's experience in the training field, conventional training, i.e. trainer-centred training often delivered to large heterogeneous groups, is limited in its ability to consider individual learning rhythms, prior knowledge and contextual needs. Interaction between trainer and participants is often minimal, reducing opportunities for personalised guidance or reflection on existing workflows. Tailored support, while effective, is typically too resource intensive to be scalable.

To address these challenges, this paper proposes the integration of E-Learning into CAD/PLM training strategies. E-Learning environments offer flexibility, self-paced progression, repeatable instruction, and increased learner autonomy, making them particularly well suited to reinforcing complex, software-specific competencies. The mixed learning model, which combines traditional in-class instruction with digital modules, is intended to enhance knowledge retention, support independent problem-solving, and promote sustainable learning outcomes.

This paper explores the potential of E-Learning enhanced training concepts for designers during software transitions. It focuses on three key research questions:

- How suitable is E-Learning in supporting training during transitions to new CAD/PLM systems?
- In what ways can E-Learning be integrated into existing training processes?
- What added value does E-Learning bring to the effectiveness and scalability of designer training?

2 GENERAL CHARACTERISTICS OF E-LEARNING ENVIRONMENTS

E-Learning, defined as the use of digital media and virtual platforms for learning independent of time- and place, enables personalised, self-paced instruction tailored to individual needs [2]. This flexibility is particularly effective for large, heterogeneous training groups, as learners progress at their own rhythm without being constrained by group dynamics [3]. Unlike traditional formats, E-Learning environments are designed to be adaptive and interactive, adjusting to user input and learning progress [4].

Given these attributes, it was recognised that E-Learning could be integrated into ARTECH's training concept to empower participants to engage more proactively while accessing course content anytime and anywhere, significantly reducing logistical barriers.

The development of E-Learning content typically follows two iterative phases:

1. Content development: This involves defining learning objectives, structuring materials into modules, selecting or configuring a learning management system (LMS), and creating multimedia elements (e.g., videos, simulations, quizzes) aligned with didactic strategies such as active learning and scaffolding.
2. Content delivery: It focuses on making materials accessible via the LMS, guiding learners through content (independently or within deadlines), and integrating assessment, feedback, and progress tracking.

This cyclical process emphasises continuous refinement and learner engagement.

Key benefits of such environments include unrestricted access to materials, improved time management, reduced cognitive overload, and formative feedback on individual performance. Learners also benefit from increased autonomy and motivation, as they are not constrained by group pace. While E-Learning offers clear pedagogical and logistical advantages, its success depends heavily on thoughtful instructional design and integration into broader training strategies [5].

Further information on E-Learning environments can be found in the references cited above.

3 ARTECH'S TRAINING PROCESS WITH E-LEARNING

The integration of an E-Learning environment into the training of experienced designers adopting new CAD and/or PLM systems seeks to establish a holistic and flexible learning model. This model allows participants to combine structured, instructor-led sessions with self-directed learning through multimedia content tailored to their professional context.

The resulting approach corresponds to the concept of Blended Learning, defined in [6] as the convergence of two traditionally distinct modes of instruction: face-to-face learning and decentralised learning. In the post-pandemic context, "face-to-face" is no longer limited to physical co-presence but broadly refers to synchronous interaction, whether in physical classrooms or virtual meeting environments. By incorporating both synchronous and asynchronous formats, this blended model aims to increase training accessibility, relevance, and effectiveness of training for professionals transitioning to new design systems. Figure 1 provides a visual representation of this integrated learning concept.

3.1 Initial situation

At ARTECH, traditional training was initially offered in two formats: Live online sessions via a dedicated platform or in-person sessions conducted either on-site at ARTECH or at the client's location. These sessions followed a trainer-centred model, where the instructor is the primary facilitator of knowledge and skills transfer. Prior to delivery, a detailed training agenda was developed collaboratively with the client. This agenda outlined the session schedule, learning objectives, and expected outcomes for each topic.

A key challenge in conventional training is to balance breadth of content with sufficient depth within a limited timeframe. ARTECH addresses this through meticulous planning and the pedagogical expertise of its trainers. The agenda is structured to cover a wide range of software functionalities, with each topic supported by demonstrations, practical applications, and, where possible, hands-on exercises.
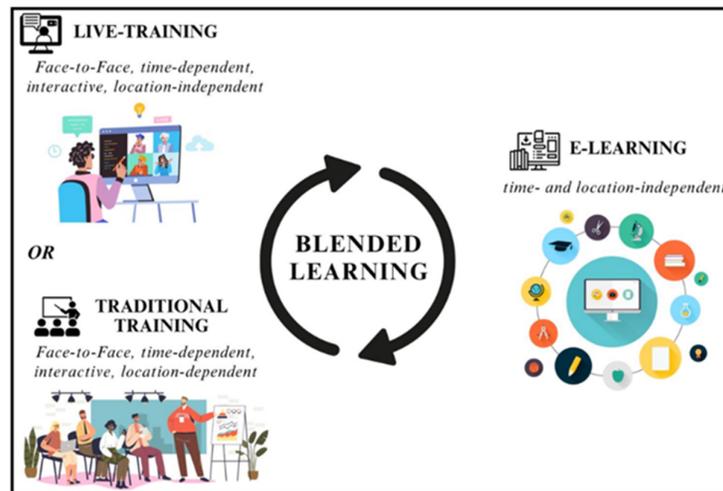
Figure 1. General Blended Learning concept

The trainer is responsible for executing the agenda while adapting to the dynamics of the sessions. This includes presenting software features, exploring configuration options, and contextualising use through real-world examples. Trainers also facilitate exercises that reinforce understanding, while remaining responsive to participants' questions, addressing them in real time or following up as needed.

Despite these strategies, time constraints often prevent in-depth exploration of all topics. Trainers must therefore carefully manage the pace of sessions, making real-time decisions to maintain alignment with learning objectives. Moreover, knowledge retention from live sessions can be limited. To address this limitation, ARTECH introduced a complementary E-Learning component, enabling learners to revisit key concepts, access additional resources, and reinforce understanding at their own pace. This blended approach enhances long-term knowledge retention and learner autonomy.

3.2 Development of an E-Learning environment at ARTECH

To train users in a targeted and sustainable way, E-Learning tools are proving to be an innovative and effective solution combining flexibility, accessibility, and learner engagement while meeting the specific needs of each audience. Numerous studies highlight the benefits of E-Learning in corporate and technical training, particularly in increasing learner autonomy and improving long-term retention through active engagement [7]. The development of the E-Learning environment for the project discussed in the context of this paper is guided by the principle of practical skills transfer. This approach goes beyond the transmission of isolated procedures by embedding them in their systemic and strategic context. By using the web-based training (WBT) method, ARTECH ensures that learners understand not only how a process is executed, but also why it is necessary, thereby promoting a deeper and more comprehensive understanding.

A major feature of this environment is the use of interactive and multimedia elements that engage learners and maintain their attention. Processes related to CAD and PLM software are demonstrated through dynamic visual content, which can include background information tailored to the learner's context. In parallel, users are encouraged to complete practical tasks that reflect real-world use cases. These exercises are designed not only to assess understanding but also to enable the direct application of knowledge. Instructions and exercises are displayed simultaneously on the screen, typically with the explanatory content on the left and the interactive task on the right, allowing learners to practice while referring to contextual guidance. This dual presentation reinforces both procedural knowledge and strategic insight.

To ensure the highest didactic quality, ARTECH develops its E-Learning content in close collaboration with experienced CAD and PLM trainers, as well as with key users from the customer's organisation. This co-creation ensures that the modules are both pedagogically sound and aligned with operational realities. One of the key assets of ARTECH's E-Learning system is its flexibility: learners can progress through the content at their own pace and from any location, making it ideal for globally distributed teams. The use of standardised content promotes consistency across departments and sites, while the interactive format maintains learner motivation and supports sustainable skills transfer.

The E-Learning phase is implemented using *Articulate Storyline 360* software, chosen at the client's request due to its familiarity within their organisation. This platform supports the delivery of interactive tutorials, video demonstrations, and exercises based on real-world CAD/PLM workflows. Built-in assessment tools allow for the evaluation of learners' accuracy, correct tool usage, and compliance with design constraints. Instructional videos help explain key concepts, while clearly defined click paths and sequences guide learners through the material intuitively, minimising cognitive load and improving navigation.

To further enhance the learning experience, ARTECH integrates interactive features such as hotspots, context-sensitive pop-ups, and embedded knowledge checks that allow learners to validate their understanding in real time. Gamification elements such as progress tracking and micro-rewards are also used to increase user engagement and reinforce motivation. These elements transform the passive consumption of information into an active, learner-driven experience.

The platform is accessed via the company's secure internal intranet, allowing users to engage with the content from their workplace or remotely. With appropriate credentials, learners can revisit the material as often as required, supporting flexible, on-demand training. In addition, the platform tracks individual learning paths, giving users the possibility to continue where they stopped and explore content according to their level of knowledge and specific interests.

ARTECH's E-Learning platform is built around the principle of personalisation. Learners can choose how deeply they want to engage with specific topics through optional in-depth content and self-guided quizzes. The system supports role-based access, ensuring that users are only exposed to content relevant to their responsibilities and avoiding information overload. Learning paths can be customised to reflect the learner's prior knowledge and goals, thereby making the experience both efficient and meaningful.

Finally, to maintain a high standard of relevance and usability, ARTECH regularly updates the platform's content and design to meet users' requirements. Feedback is continuously gathered through surveys, functionality tests, and user analytics, such as time spent on task and abandonment rates. These data points provide the basis for iterative improvements. The result is an interactive, visually appealing and user-friendly platform that promotes engagement and supports different learning styles. It delivers sustainable training outcomes that are tailored to the evolving needs of modern industrial environments.

3.3 Integration of Blended Learning into ARTECH's training strategy

Blended Learning has become a widely adopted educational strategy in corporate and technical training environments. As mentioned earlier, this pedagogical model combines the strengths of synchronous and asynchronous formats to offer learners a flexible, personalised learning experience. This combination of in-person interaction and digital content delivery enables organisations to address learners' varying needs while ensuring efficiency and scalability [8], [9]. Although the structural possibilities for implementing Blended Learning are nearly limitless, although certain models have become established in practice due to their pedagogical effectiveness and operational feasibility. Figure 1 illustrates the flexible combination of learning forms, while Figure 2 outlines four common models used in organisational training contexts. These models can be adapted and expanded to reflect the need for customisation based on organisational goals, technological infrastructure, and learner profiles [8].
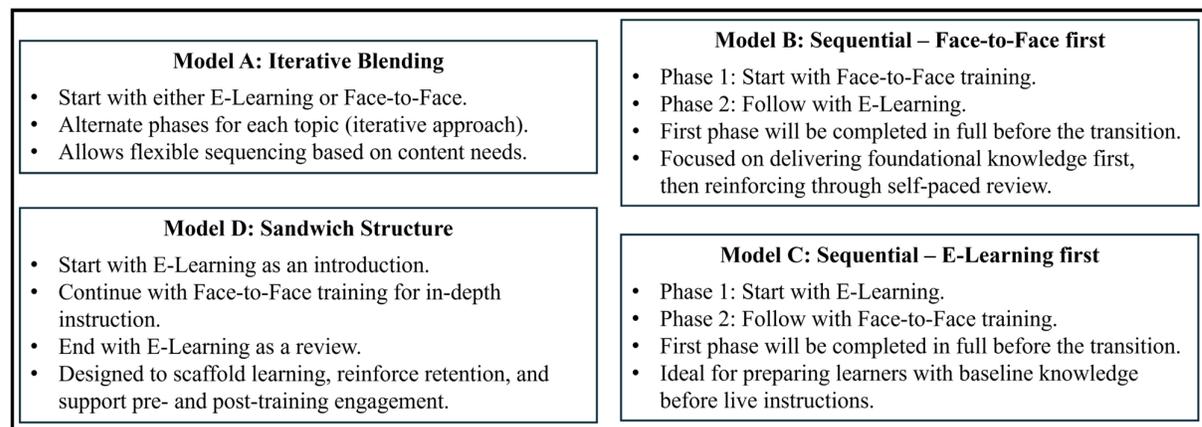
Model A: Iterative Blending
- Start with either E-Learning or Face-to-Face.
- Alternate phases for each topic (iterative approach).
- Allows flexible sequencing based on content needs.

Model B: Sequential – Face-to-Face first
- Phase 1: Start with Face-to-Face training.
- Phase 2: Follow with E-Learning.
- First phase will be completed in full before the transition.
- Focused on delivering foundational knowledge first, then reinforcing through self-paced review.

Model D: Sandwich Structure
- Start with E-Learning as an introduction.
- Continue with Face-to-Face training for in-depth instruction.
- End with E-Learning as a review.
- Designed to scaffold learning, reinforce retention, and support pre- and post-training engagement.

Model C: Sequential – E-Learning first
- Phase 1: Start with E-Learning.
- Phase 2: Follow with Face-to-Face training.
- First phase will be completed in full before the transition.
- Ideal for preparing learners with baseline knowledge before live instructions.

Figure 2. Typical Blended Learning models

ARTECH has adopted Model B of the above-described models for an international organisation with locations on four continents. This model includes an initial intensive face-to-face training phase, followed by a structured self-learning phase using E-Learning materials developed, created and edited by ARTECH. This model was selected for its ability to combine the strengths of synchronous training such as immediate feedback and structured learning with the flexibility and reinforcement potential of E-Learning. The face-to-face sessions, organised in groups of approximately twelve participants, enabled focused instruction on all key topics relevant to the organisation. However, the condensed nature of these sessions, necessitated by time constraints, limited opportunities for participants to fully explore complex software functionalities in depth or reflect on real-world applications. To address this, the topics covered during the face-to-face sessions were reviewed and expanded upon the subsequent E-Learning modules, thereby reinforcing understanding and encouraging long-term learning.

The pedagogical structure of the E-Learning environment used during the self-learning phase was based on modular independence. Each training topic corresponded to a dedicated digital learning file containing concise, targeted explanations tailored to users' practical needs. Progression within the platform was dependent on successfully completing interactive exercises or quizzes embedded in each module. This mechanism ensured active engagement and the immediate application of knowledge. The order in which each file was completed was flexible, allowing users to follow a learning path that matched their preferences and professional priorities. Participants were given a defined timeframe in which to complete their modules, and trainer support was available during this time to answer questions and reinforce concepts as needed.

ARTECH's Blended Learning approach uniquely integrates synchronous, asynchronous, and dialogical learning elements into a learner-centred, cohesive model. This comprehensive design ensures continuity in the learning process, promotes the practical application of knowledge, and provides personalised support to meet the diverse needs and learning preferences of participants. By combining real-time interaction, flexible self-paced study and structured dialogue, the ARTECH model fosters an engaging, adaptive and rich educational experience that meets modern training standards and professional development goals.

4 RESULTS AND ANALYSIS

To assess the effectiveness of ARTECH's Blended Learning concept, an anonymous written survey was conducted among participants, who had undergone joint CAD/PLM training during a software transition. Over 70% of learners responded, rating the overall training concept with a high score of 88%. While the training was positively received, over 10% of participants noted a drawback: the E-Learning phase did not always enable immediate resolution of queries, particularly when trainers were unavailable during asynchronous learning sessions. Nevertheless, the modular structure of the digital training meant that learners could complete other modules or consult their peers while waiting for feedback.

A more in-depth evaluation was conducted in two phases: one after the face-to-face training, and the other after the E-Learning segment. This dual assessment aimed to measure learner satisfaction, engagement, and knowledge retention. Satisfaction was rated at 80% at the end of the in-person phase, increasing by 5% after the E-Learning portion. This improvement was attributed to the personalisation options available on the digital platform, which allowed learners to control the order and depth of their engagement with each topic and allocate more time to areas with which they were less familiar. Learner engagement also increased significantly, rising from 50% during the face-to-face training to 85% after the e-learning segment. This increase was primarily due to the flexibility of the e-learning format, which enabled participants to learn at their own pace, free from rigid scheduling constraints. Other contributing factors included the visual appeal, interactivity and relevance of the platform to real-world work scenarios. Most notably, knowledge retention increased from 75% after the face-to-face training to 90% after the E-Learning phase. This 15% improvement was primarily due to the multimedia elements and the learners' ability to review content at their preferred pace, which reinforcing understanding over time. Figure 3 summarises the results of the evaluation, which highlighted that ARTECH's blended approach results in greater learner engagement and knowledge retention. The key insight for educators is to move beyond traditional formats and incorporate flexible, autonomous learning environments that are context-aware and learner-centric, and that are supported by accessible communication channels tailored to diverse learner groups.
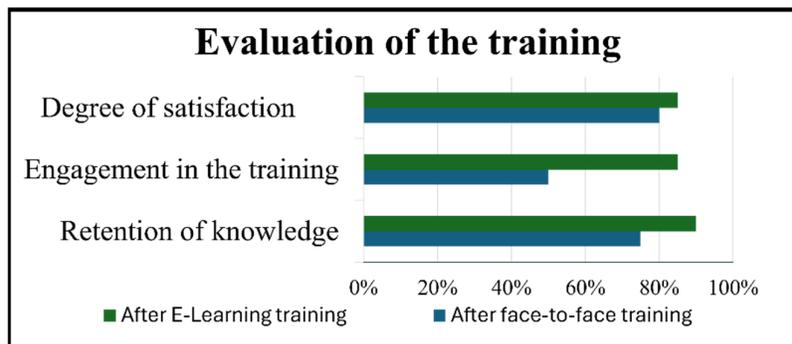
Figure 3. Results of the training assessment

5   CONCLUSION AND PERSPECTIVES

This study examines the applicability of Blended Learning, which integrates face-to-face training with E-Learning (see. Figure 1), for training experienced designers in the context of CAD and PLM software implementation. Following the client's preference for a sequential model, Model B (see Figure 2) was implemented. To ensure the training was both relevant and efficient, it was tailored to the participants' established workflows, avoiding generic content and promoting immediate productivity with the new tools. A post-training survey revealed the high effectiveness of ARTECH's Blended Learning approach (see Figure 3). Although the inclusion of an E-Learning phase required additional time from learners, the benefits in terms of flexibility, engagement, and knowledge retention outweighed this investment. According to the review comments, the success is attributed to the pedagogical quality of the materials and the positive reception by learners.

To further support knowledge consolidation and preparation before the software launch, live Q&A sessions titled *Meet the Experts* will be implemented. These interactive sessions will connect training participants with subject matter experts, enabling them to ask specific questions, discuss real-world applications and exchange knowledge. Recordings with transcripts of these sessions will serve as additional ongoing learning resources.

The modular and customisable nature of this training approach means it can be adapted to various organisational contexts. Aligning content with users' tools, workflows, and skill levels, the approach promotes smoother transitions during software rollouts, reduces resistance to change, and supports long-term skill development through a structured blend of guided instruction and applied learning.

REFERENCES

[1] acatech *Faszination Konstruktion - Berufsbild und Tätigkeitsfeld im Wandel*, 2012 (Springer).
[2] Arnold P., Kilian L., Thillosen A. and Zimmer G. *Handbuch E-Learning: Lehren und Lernen mit digitalen Medien*, *3. Aktualisierte Auflage, 2013* (W. Bertelsmann Verlag, Bielefeld).
[3] Rey G. D. *E-Learning: Theorien, Gestaltungsempfehlungen und Forschung*, 2009 (Hans Huber, Bern).
[4] Stoyanov S. and Kirchner P. Expert concept mapping method for defining the characteristics of adaptive E-Learning: ALFANET project case. *Educational Technology Research and Development*, 2004, 52, 41-54.
[5] Kossack F., Kattwinkel D. and Bender B. G. D. Adaptive E-Learning for the Engineering Design Education at Ruhr-University Bochum. In International Design Conference, Vol. 2, May 2022, pp. 2313-2322 (Proceedings of the Design Society, doi:10.1017/pds.2022.234).
[6] Curtis J. B. and Charles R. G. *The Handbook of Blended Learning: Global Perspectives, Local Designs*, 2005 (Pfeiffer Publishing, San Francisco, CA).
[7] Chen E. T. Successful E-Learning in corporations. *Communications of the IIMA*, 2008, 8(2), Article 5.
[8] Jopen B. and Bohne F. *How To: Blended Learning Konzept erstellen, Tipps, Strategien & Leitfäden aus der Praxis*. Available: https://www.ecademy-learning.com/ausbildung-digital/blended-learning-konzepte/ [Accessed on 2025, 24 January], (2025).
[9] Sprungk H.-M. and Witzke M. *What blended learning means*. Available: https://www.blink.it/en/blended-learning-in-practice [Accessed on 2025, 29 January], (2021, 18 August).