



LESSONS LEARNED DURING A BLENDED TRAINING FOR NEW EMPLOYEES IN AEROSPACE COMPANIES

D. Pourtoulidou¹

Technische Hochschule Ingolstadt
Ingolstadt, Germany

A. Frey

Technische Hochschule Ingolstadt
Ingolstadt, Germany

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ABSTRACT

This research follows a previously published paper presented by Pourtoulidou and Frey which describes the conversion of a classroom-based to blended training for new employees entering aerospace companies [1]. This paper presents the lessons learned that derived from the analysis of the results after evaluating the blended training according to the participants', subject matter experts', and trainer's perspectives.

Prior to the training, Pourtoulidou and Frey analyzed the demands of aerospace companies and the labor market in order to develop this introductory training [1]. The classroom-based training was developed, implemented and evaluated in 2018/2019. Utilizing this evaluation, the blended training consisted of an online phase, which

¹ *Corresponding Author*

D. Pourtoulidou

dpourtoulidou@gmail.com

lasted six months and provided access to lecture videos, literature material, quizzes, forums and virtual meetings over the Moodle platform. In the middle of the online phase, a face-to-face session took place in October 2021 in which the participants worked with practical applications and associated with subject matter experts operating directly in industrial projects.

The lessons learned focus on the training development for employees' blended courses and on the specific limitations resulting from developing a joint training for entry-level aerospace engineers. The flexibility and further benefits of the training's online phase were well received from the participants, while the opportunity to meet, work and exchange experiences in person during the training was highly appreciated. The impact of COVID-19 on participants' experience and feedback was also visible and commented on.

1 INTRODUCTION

In 2017 a network of eight German companies formed under the publicly funded research project "Avionic System Software Embedded Technologie 2" (ASSET-2) formulated the demand for an introductory training course for new employees entering the aerospace industry [1 - 9]. This demand derives from the recruitment process in the aerospace industry that draws employees from pertinent fields, e.g. automotive engineering and STEM. Aerospace companies need to reach out to software engineers or software architects with a wide variety of academic and professional backgrounds. Afterwards, the challenge remains for each company to train the new software engineers or software architects through training courses, which cover the basics for their introduction to aerospace software development depending on their role.

2 PROJECT BACKGROUND

2.1 ASSET-2

Ingolstadt University of Applied Sciences developed an introductory training course as a classroom-based training for the "knowledge transfer" subproject of ASSET-2 to cover the companies' demand [2 - 9]. This training contained theoretical knowledge, practical applications and contact with subject matter experts in order to offer to companies' new employees a common elementary introduction to aerospace software development. The development of the classroom-based training started with the needs analysis; followed by the implementation and the evaluation of the training [2 - 9]. The feedback from the participants and the companies confirmed the initial consideration for the training and revealed the need for individualization of the training, as the individual background of the participants shows a wide spread. The participants expressed their individual learning needs and stated that they were in favor of the opportunity to self-regulate which parts of the training they will attend.

2.2 IDEA

Based on the ASSET-2 feedback, the further development of the training started in 2020 under the publicly funded research project “Integrierte Design- und Entwicklungsumgebung für Aerospace” (IDEA) by the Federal Ministry for Economic Affairs and Energy². The subproject “knowledge transfer” within IDEA aimed at minimizing the restrictions and disadvantages of the aforementioned classroom-based training by offering flexible training units that fit into the employees’ working schedules and make the training adjustable to participants’ needs. The ASSET-2 main goal of introducing the new employees to aerospace software development and promoting the knowledge transfer among the participants remains a primary goal for the extended network of twelve German aerospace companies and academic institutions. However the IDEA blended training, which is the result of the conversion of the ASSET-2 typical classroom-based training, foregrounded the learning needs of the individuals. The criteria for the conversion of the ASSET-2 classroom-based to IDEA blended training are described in a prior publication of the authors [1].

3 LITERATURE REVIEW

The development of blended or hybrid trainings started before the 2000s and therefore is a rather old trend. The sudden obligatory shift in online learning that resulted from the mandatory reduction of the face-to-face training sessions since the beginning of 2020 is obvious and lies in the COVID-19 restrictions. The explosion of the amount of online trainings and online digital learning resources is evident.

Since the early 2000s, researchers have studied the use of blended learning in training development [10]. Training courses containing a mix of online and face-to-face learning modules are called blended or hybrid courses [11]. The positive influence of blended approaches on learning outcomes has been shown through studies in university settings or in vocational education [12, 13, 14]. Vitrally relevant for this research are studies about professional trainings, which were developed for employees and take place within employees’ current job position aiming at their professional development. The advantages of professional trainings concern both the employees and the employers. Employees benefit from blended learning methods due to the flexibility and the accessibility of participating in blended courses [11]. Employees’ learning success results in increasing employers’ benefits while reducing the costs of training development [11, 15]. An explorative study in a Belgian-Dutch context confirmed these benefits of blended learning [16]. Other studies highlight the ability to enrich the learning process in a blended course with the use of online material beyond one institution, and to allow the participants to engage with it at their own pace [17, 18]. Research evidence shows the improvement of the effectiveness in industrial trainings when comparing the different

² It was renamed to Federal Ministry for Economic Affairs and Climate Action in January 2022.

learning approaches using experimental design [19]. The dropout rate is, also, positively influenced by blended learning but is highly dependent on the setting of the blended course and is not relevant for this research [20].

4 METHODOLOGY

This chapter describes the research methods, the implementation and analyses the feedback of the blended training after its evaluation from the subject matter experts', the trainer's and the participants' perspective.

A challenge for evaluating these trainings is that the companies demand data protection and absolute confidentiality regarding the employees and the training material. The mandatory data protection issued for the companies and their employees forbid any external evaluation. This influenced the methodology of evaluating the ASSET-2 classroom-based and the IDEA blended training, which is described as follows. The evaluation was executed by interviewing all contributors in semi-structured interviews. Due to the geographical distance the researcher conducted telephone interviews with the 22 participants and the 3 subject matter experts and a face-to-face interview with the trainer. The collected data were recorded via a voice recorder, anonymously transcribed and analyzed using content analysis.

4.1 ASSET-2

The ASSET-2 classroom-based training was implemented in October 2019 in which 11 employees participated [2 - 9]. At that time, they were starting their careers within the network in the field of aerospace software development in Germany. This training lasted two days and took place in Ingolstadt. The participants of this training belonged to 6 different companies and had various educational backgrounds from STEM fields. Before the training, the participants answered a prior-training questionnaire about their knowledge and their educational and professional background. Directly after the training they were asked to fill out a post-training evaluation questionnaire with close-ended and Likert Scale questions. Approximately three months afterwards, telephone interviews took place to get feedback after the new employees had actively been participating in work projects and had settled in their new position.

4.2 IDEA

The implementation of the blended training got caught up by the COVID-19 restrictions. During the COVID-19 restrictions in 2020 and 2021, the availability of the participants for the face-to-face session was difficult to foresee.



The duration of the online phase was planned to last 7 months during which the face-to-face session would take place. During the online phase the participants had access to lecture videos, literature material, quizzes, forums and virtual meetings over the Moodle platform. After the conversion of the ASSET-2 classroom-based training, the proportion allocated to the online phase was planned to cover approximately 78% of the training's material, which resulted in approximately 22% for the face-to-face session [1]. The average commitment for the online phase was estimated to be 10 hours. The online modules were staggered in chapters not dependent on each other. A participant could either skip a chapter or a video. Skipping an online module or part of it was up to each participant according to their educational and professional background. All online material was from the beginning of the online phase available with no restriction other than not being able to download the videos due to license restrictions. Rewatching a video at any time was possible with a working internet connection.

The duration for the face-to-face session was originally planned to last 5 work hours but was extended to one day (approximately 8 work hours) due to adding extra time for discussion and break time. The desired date for the face-to-face session was planned so that the participants could access the online material before and after the face-to-face session simultaneously while working in their business projects. The face-to-face session consisted of multiple parts. It started with a team event to get to know each other that took place the day before the main session. The participants were welcomed and met each other face-to-face with the trainer and the experts in an informal environment. The team event reached all participants, where 70% would need to travel a day in advance to arrive in Ingolstadt and 30% were locally based. As part of the actual face-to-face session subject matter experts were invited to offer insights about common problems in the field and advice according to their past experience. Also the participants engaged in group activities with practical applications.

The actual implementation of the IDEA blended training "Fundamentals in Avionics Software Development: Verification" took place in 2021/22. After consultation with the companies in order to ensure the maximum availability of the participants, the online phase started in August 2021 and ended in February 2022, the face-to-face session took place in October 2021. 11 employees from 5 different companies participated in the blended training.

The methodology of evaluating this training consisted of three steps. At first, before engaging with the training, the participants completed an online questionnaire about their educational and professional background. The online questionnaire prior to the training investigated the learning needs of the participants while they were starting their new job position. At the end of the face-to-face session, directly after participating in the training the participants answered a second questionnaire to assess in which level the materials and the teaching methods of the online and face-



to-face sessions correspond to their needs and learning preferences. Both questionnaires contained multiple choice, Likert scale and open-ended questions. Step three included interviewing the participants, the trainer and the subject matter experts, who contributed in developing and implementing this training. Approximately three months after the face-to-face session the participants assessed the training's effects on their current professional role and their everyday working challenges in interviews. The interviews with the participants were conducted three months after the training in order to evaluate the training after gaining relevant experience in their new position. In addition to the participants' interviews, interviews with the trainer and the subject matter experts took place, which assessed the training from their perspective.

5 RESULTS

The results after evaluating the two trainings are presented here without referring to any personal information on the participants and every person that contributed to the trainings' development and implementation. In every research study the participants' personal data are highly protected. An additional requirement for the ASSET-2 and IDEA research projects was the confidentiality regarding job projects in which the participants are currently or were formerly working. The network's companies cooperate within the projects but are also competitors in similar and/or the same fields. Due to companies' privacy policies the employees participating did not take an exam or a test that would evaluate their knowledge. The participants could at any step of the evaluation withdraw their consent to participate in this study or skip a question. Their feedback on these trainings relied on their self-assessment according to their personal experience and opinion.

5.1 ASSET-2

The evaluation of the ASSET-2 classroom-based training outlined two main points; the demand for an introductory training in aerospace software development and the accessibility of the classroom-based method for this training [2 - 9]. The new employees that attended this training entering the aerospace industry with relevant or non-relevant educational and professional background confirmed the demand for such an introductory training. The appropriate time of participating in this was concluded to be directly after entering and up to one year working within the aerospace industry. The training method satisfied 80% of the participants and contributed to gaining knowledge. Nevertheless, they expressed further needs such as individualizing the training due to its long duration and large input, which was for some participants maybe already known or not absolutely related to their current position. 80% of the participants were in favor of the opportunity to self-regulate which parts of the training they would attend. 70% stated that they are willing to attend a training with online sessions that will cover a part of the training. Only 10% answered positively to participating in a strictly online training. All participants assessed as most important the practical activities and the interaction with the other



employees from different companies and projects, with the trainer and the subject matter experts. The feedback from ASSET-2 was extensively analyzed in [1].

5.2 IDEA

The evaluation of IDEA blended training offered the following results, which will be presented from three different perspectives: the participants', the subject matter experts' and the trainer's perspective.

Participants' perspective

The IDEA blended training was well received from the participants. All participants mentioned as main benefits of this blended training the accessibility and the flexibility. Everybody appreciated participating asynchronously during the online phase without being limited in place and time when accessing the material and completing any tasks. 60% of the participants accessed the whole material before the face-to-face session, 20% of them only parts of it before the face-to-face session and 20% after the face-to-face session due to lack of time. The 20% of the participants, which did not access the material before the face-to-face session, stated during the interview that they intend to engage with it in the future depending on their workload.

All participants of the IDEA blended training commented very positively on the opportunity to meet and discuss with other employees from different departments and companies, who are experienced approximately in the same level as themselves. 90% of the participants stated they experienced a trustworthy environment and were encouraged to express their problems and questions during the face-to-face session. The participation in the team event was highly regarded by all. In particular, 70% explained that the team event contributed to "*breaking the ice*" and to feeling assured that neither comparisons nor (informal) assessments take place during the session. Also the participants living near the place of the training, stated that they were glad that they had joined the team event.

According to 70% of the participants, the contribution of the subject matter experts and the trainer played an important role in the atmosphere of the training because they were open and shared their experience from real-life work projects transmitting a feeling of "*everybody faces problems*". This was highlighted by 30% of the participants as "*cool, friendly and approachable experts*" which encouraged their self-confidence. In general, all participants liked the use of the blended learning method and emphasized the importance of the face-to-face session for collaborating.

For 60% of the IDEA blended training's participants this was the first training and business trip within their new position in their new company and in this industry. 40% mentioned that they were likely more excited to participate in a face-to-face training in October 2021 because of the long absence of face-to-face trainings and generally face-to-face sessions due to the past two years of COVID-19 restrictions.

Subject matter experts' perspective

This interest for face-to-face interaction was also reported from the subject matter experts, which participated in the face-to-face session. The subject matter experts presented the daily problems and experience gathered, while working in this field. 40% of the participants gave feedback personally to the experts directly after the expert discussion during coffee and lunch break. The experts perceived that the participants were feeling able to discuss openly and showed interest about their experience.

Attending the face-to-face session remains time-consuming for the subject matter experts but according to their opinion, this contributes to everybody's openness, and feeling of safety on a professional level. So, as one subject matter expert stated, *"can the participants express themselves without being afraid of being judged, what enriches the training outcomes"*.

Trainer's perspective

The trainer received positive feedback from 40% of the participants directly after the face-to-face session. The trainer's feedback on the blended training highlights the difficulties of implementing a blended training. The flexibility during the online phase resulted in a lack of information about the participants' learning process during this phase. How the participants were engaging with the online materials was visible for the trainer only through their participation in the quizzes. This allowed some assumptions but the extent of the engagement remains unknown, since a participant may have taken a quiz without having watched the relevant video. Therefore, the trainer is required to be prepared for participants that are not at all introduced to the trainings' subjects. This issue did not negatively influence the implementation of the face-to-face session because of the session's topics. In other technically more challenging trainings and in particular exercises, which would require specific technical knowledge, this could cause problems for the training's implementation.

6 LESSONS LEARNED

The above results confirm the importance of the blended learning's benefits for employees entering a new role at a company and led us to following valuable lessons learned for the blended training.

- Offering a blended introductory training helps to quickly cover any theoretical deficits of new employees in the first stages of their new role. Not having to wait until a specific amount of participants is available for a training to be carried out results in a significant gain for companies [16, 18].
- Clearly structured material in the online phase containing all information regarding the training and its implementation are necessary. This determines the level of flexibility that can be offered.



- Self-assessment tools and/or a final exam aiming at a certificate for the successful participation enhance the gain the training has for the participants. The opportunity to choose themselves if they take an exam or not remains important.
- Employees working in tech-related industries possess a professional tech affinity and welcome the use of technologically advanced tools. This assured that the target group of this training would be able to engage easily with the online material. Nevertheless, offering tech support during the online phase is considered an inevitable requirement to ensure the desired level of flexibility regarding user experience.
- The value of human interaction is proven to positively influence the effectiveness of blended learning trainings [21]. The time allocated to the face-to-face session is highly valued by the participants and ought to be filled with activities which reinforce interaction and promote developing practical skills. Even small coffee breaks as the ones that were planned directly after the expert discussion with the subject matter experts are valuable, as participants expressed their appreciation for presenting examples and problems, which the experts faced in past and present projects. The participants in conjunction with this stated that the trustworthy atmosphere eliminated their hesitation of expressing and comparing themselves with other new employees. This confirmed their confidence and self-esteem in their professional expertise.
- Our experience confirmed the need for at least 22% of face-to-face session, but the blend between face-to-face and online modules depends on the training material and the availability of the participants [1]. The time allocated to the face-to-face session can differ according to the availability of the participants. One work day devoted to the face-to-face session was evaluated as adequate for this training but a second day devoted to extra practical exercises would be welcomed.
- The subject matter experts enhance the training's outcome but have to align with the training's goals. The communication between the subject matter experts and the trainer influences the atmosphere during the face-to-face session.
- According to the experience gained during the IDEA training's implementation if the same level of knowledge is needed for a practical application, it is important to either require specific preparation from the participants prior to the face-to-face session or plan more time for introducing the learners to the subjects of the exercises. Problems deriving from the flexible conditions during the online phase depend on the content of the training and the target group. Answering a short questionnaire before attending the face-to-face session and stating the level of engagement with the online modules may offer insights to the trainer about the knowledge level of the participants taking part in the face-to-face session and if they have questions up to this point. The absence of such requirements for this training was purposely decided in

order to offer the maximum level of flexibility in engaging with the online modules.

- 40% of the participants explicitly stated that they preferred gathering their questions during the online phase and asking those in the face-to-face session rather than contacting the trainer during the online phase. Although different options of contacting the trainer and posting a question in the online platform of the training were available, they mentioned that they wanted to discuss their question(s) with the trainer in person during the face-to-face session. Planning a time slot during the face-to-face session for answering these questions is needed in any case. The trainer and/or the subject matter experts should expect questions during the face-to-face session that were gathered during the online phase or the practical applications. Although there could be a time slot for clarifying questions in the beginning of the face-to-face session, we suggest to plan, also, a closing open discussion, where participants can express any unsolved issue.

7 SUMMARY

This paper presented the lessons learned that derived evaluating the blended training according to the participants', subject matter experts', and trainer's perspectives. It outlined the gain for new employees entering the aerospace industry after participating in a joint training within the network. The benefits of the flexibility a blended training offers were confirmed while highlighting the necessary existing conditions during the online phase: clear structure, guidelines, self-assessment tools and tech support were mentioned as the most important. The face-to-face session has proven to be an absolutely essential part of a blended training due to the interactions among all associates. Successful interactions require communication between the trainer and the subject matter experts prior to the training and additional time for open discussion during the face-to-face session. The participants emphasized the positive effect of interacting with the subject matter experts and the trainer on their confidence and self-esteem. The ideal blend between online and face-to-face modules is not a universal fixed percentage because it highly depends on the training material and objectives. Conducting further research in professional blended trainings of different industries may enlighten the influence of such trainings on the employees' later performance.

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