PlaySAFe: Results from a Virtual Reality Study using Digital Game-Based Learning for SAFe Agile Software Development

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Abstract. A common strategy to train software practitioners in agile frameworks is to have employees undertake classroom-based training. However, due to its nature, participants are lectured for a scheduled time-line with little necessity to interact. In particular, classroom-based training often might not provide substantial trainee interaction, which could result in apathy. To tackle this issue, we conducted empirical research to investigate the role of digital game-based learning (GBL) in employees' training on the Scaled Agile Framework (SAFe). To figure out whether gameplay was a preferable training method, PlaySAFe (i.e., a 3D game) was developed within the study's scope and tested with nine active SAFe practitioners from an industrial setting. Restrictions imposed by the COVID-19 pandemic have forced many to seek alternative means of teaching and learning. In particular, the findings obtained from the tests illustrate that PlaySAFe can be effectively used as a complementary tool that supports SAFe classroom-based training. This study has highlighted numerous benefits of GBL, such as allowing newcomers a quick and efficient means to learn and understand the practical groundwork of SAFe in advance of learning more theoretical concepts in conventional training.

Keywords: Software engineering processes, digital game-based learning, agile frameworks, SAFe.

1   Introduction

As technology becomes an increasingly predominant element to individuals' daily lives, software companies are under increasing unrelenting pressure to improve their software development's quality and speed. As a result of this demand for continuous delivery and deployment, organizations are placing greater emphasis on methods of working to facilitate this requirement [1]. Many organizations are looking at agile frameworks such as the Scaled Agile Framework (SAFe) to

achieve this, as it is one of the most prevalent utilized frameworks according to the State of Agile Survey [2]. Frameworks such as SAFe guide an organization on a set of practices and processes to implement within their organization [3]. In order to successfully carry out an agile transformation, organizations require employees to be trained in these frameworks [4].

Digital game-based learning (DGBL) refers to the use of games for expected learning outcomes [5]. The expression emphasizes the importance of using digital games for educational purposes [6]. The industry-focused research discussed in this paper looks to DGBL to improve the educational experience of SAFe. In general, the goal for designing a DGBL approach to train on SAFe practices is to establish the experiences of participants, such as learning experience [7], gamified interaction [8], and enjoyment, to satisfy the desired conditions (knowledge gained or reinforced on the SAFe framework).

Considering the recent impact of COVID-19, whereby classroom-based training may no longer always propose an effective means of student engagement [9], this research offers a novel approach for training software practitioners on SAFe. To achieve this aim, this paper outlines an approach in which involves research participants playing a game, "*PlaySAFe*" set in a virtual world, and comparing this with a classroom-based SAFe training, "*Leading SAFe*". Therefore, it aims to demonstrate the feasibility of digital game-based training as a means of improving the current training of SAFe. To illuminate the pros and cons of PlaySAFe, the participants were interviewed about their experiences of these two different learning techniques. The results obtained from the interviews were analyzed using thematic content analysis to identify emerging themes.

The rest of the paper is structured in the following manner: Section II addresses the current literature; Section III outlines the methodology of this research; Section IV describes the results of this research; Section V presents the conclusions.

2 Background

SAFe is an agile framework that was first formally defined by Leffingwell in 2007 [10]. It is described as a way of working that applies the power of Agile but leverages the more extensive knowledge pools of systems thinking and Lean product development. SAFe's case studies have claimed benefits such as a 20-50% increase in productivity, 30-75% faster time to market, 50%+ defect reduction, and happier, more motivated employees [11]. The core values of SAFe are alignment, built-in quality, transparency and program execution [12]. Agile teams are comprised of a: Scrum Master, Product Owner and Development Team. Other stakeholders include the Release Train Engineer, Product Management, System Architect and Business Owner [13]. The SAFe Implementation Roadmap places an emphasis on employee training [3]. These activities are classroom-based and are taught by a qualified SAFe trainer. Attending this training prepares individuals to take the exam and to become a certified SAFe Agilist (SA). However, classroom-based training may be considered as an old

teaching strategy that starts to lose the impact on the participant in recent years, especially during and after COVID-19 [14]. As an alternative solution to classroom-based training during the COVID-19 pandemic or a complementary teaching tool to classroom-based training in normal life conditions, game-based learning is a popular strategy for motivating software practitioners through identifying the need for self-regulated learning (SRL) [15].

There are many studies in the literature that benefit from game-based learning approaches to increase both the level of knowledge and experience of the individuals working in several different domains such as psychology [16], military [17], education [18], sport [19], bug tracking [20], etc. To support this notion, Fauziyah et al. [21] present the idea that participants who partake in learning through games digest more in-depth materials required by corporate objectives.

In addition, Aydan et al. [22] have observed, through the use of a case study, that using an interactive learning approach makes it easier to teach the information, but also that such a system provides a better understanding of the taught concepts. In another study, De Souza et al. [23] have found that participants who partook in educational game-play found that the games added a differentiated and enjoyable experience. Furthermore, they concluded that it allowed for a better understanding of the content of the subjects worked on in the classroom. In a similar manner, Fernandes and Sousa [24] concluded in their research that game-based training of the SCRUM framework allows students to gain a solid understanding of real-world lessons that might have otherwise been overlooked. Lastly, Naik and Jenkins [25] indicated that the average marks are improved by at least 10% when a game-based learning approach is deployed in comparison to the non-game-based approach.

Although authors have conducted studies surrounding the benefit of gaming [8], this concept is still insufficiently explored when applied to the SAFe framework. Much of the existing research encompasses other agile frameworks such as SCRUM. Moreover, this paper addresses a competitive analysis between classroom-based "SAFe training" compared to a game-based "SAFe training" that lacks the existing literature.

3 Methodology

This section outlines the design of the research. A qualitative research approach was chosen to capture and describe the complexity of the phenomenon. Qualitative research aims to construct a theoretical framework that emerges from the analysis of the data gathered during the study and enables the research results to be explained coherently [26]. This research has deployed a thematic analysis approach, as it is a flexible method of identifying themes across a dataset [27]. This involves examining the research data to extract common topics, ideas, and patterns.

The research has been conducted in a multi-step model. The first step of the research plan was to produce a literature review, as discussed in Section II. Next, the research participants were selected from a software company that has

undertaken SAFe Agile Training. Using the Unity 3D Development Platform, a 3-D game was designed for research participants to play (see Figure 1). In this study, we used a semi-structured interview, i.e., a qualitative research approach where the results were evaluated using thematic analysis.

Fig. 1: The Office Environment in PlaySAFe

3.1 Participants

Participants for this study were selected based on two factors. Firstly, the participants were employees within an organization that used SAFe practices. Secondly, the participants had recently completed the classroom "*Leading SAFe*" training. They were chosen due to their industry experience of working within SAFE and so that later a comparative analysis could be conducted between the experiences of the classroom training and the game training.

3.2 Semi-Structured Interview

It was determined that due to the small sample size of 9 participants, a quantitative study would not be feasible. Therefore, for this experiment, a semi-structured interview was used. This interview was designed in order to extract information about the player's learning experience, interaction and enjoyment. This is in order to satisfy the desired conditions; knowledge gained or reinforced on the SAFe framework.

3.3 Designing a 3-D Game

For this research, the authors introduced a game as a complementary tool to the "Leading SAFe" training. A 3D game was developed using the Unity Devel-

opment Platform with the aim of training individuals on the SAFe framework. PlaySAFe's design is oriented in an office for the purpose of game players simulating SAFe practices in a regular work context. All game characters are labeled as to their role which they have within SAFe, such as a Product Owner. There are various SAFe ceremonies occurring throughout the office such as the Daily Stand-up (see Figure 2).

Fig. 2: An Example Daily Stand-up Meeting

Game players can observe which individuals attend which ceremonies in order to get a better comprehension of the framework. There are points awarded for completing challenges and answering quiz questions correctly (see Figure 3) .

3.4 Thematic Analysis

In order to analyze the data obtained from the interviews, it was determined that the authors would use a thematic analysis. This involved familiarization with the data collected, identifying ideas and main points. For the thematic analysis, the authors generated 20 sub-themes and 11 themes. From this, the authors were able to derive conclusions which we will discuss in more detail in the next section.

4 Results and Discussions

4.1 Opinions of the benefits of having of a robust SAFe training

Participants who were interviewed discussed the benefits of having a robust knowledge of SAFe. Many believed that the organization in which they work
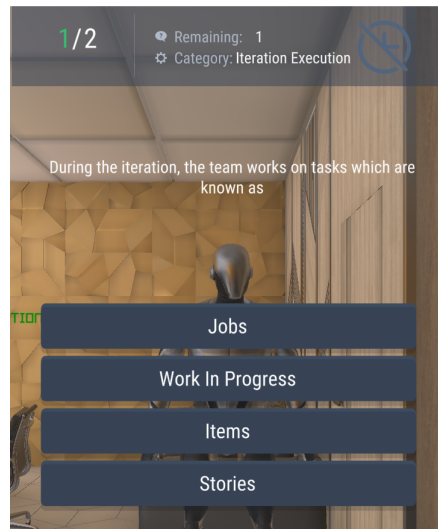
Fig. 3: An Example of a Quiz Question in PlaySAFe

implements the framework "religiously" and "strictly". They also believed that "adequate training is pivotal to having a successful, agile team." There was also an emphasis placed on the fact the SAFe training does not just occur in the classroom and that both practical and theoretical knowledge is important to get a full picture of SAFe. Participants believed knowledge of SAFe benefited trainees in a multitude of ways including stronger teamwork and more structure within the organization.

1) Stronger teamwork

SAFe teams typically consist of 8-10 individuals who meet regularly throughout the week for various ceremonies including the daily stand-up meeting [28]. Participants felt that strong SAFe knowledge resulted in better communication and visibility between team members. They believed that it also improved alignment and knowledge-sharing between team members due to the communication channels created through SAFe. As one interviewee stated:

"I think there's certainly better communication across the whole team and definitely better communication across teams. And I think when everyone understands the process, it certainly makes it easier. [...] I think it helps the team too, I suppose to work together because it's better visibility for everyone."

2) Provides structure

SAFe clearly identifies roles and responsibilities at all levels of the organization. At the team level, defined roles would include the Product Owner and Scrum Master. At the program layer, such roles would include a System Architect and Release Train Engineer. Research participants referenced the way in which a strong SAFe training prevents individuals from feeling lost in the corporate structure as it allows a clear identification of the roles in the organizations. Moreover, they identified that this structure also was useful during the execution of their day-to-day activities. Commenting on why they believed SAFe training was beneficial, one of the interviewees said:

"I think it gives us a very structured way of working, which allows for variability without chaos. It allows us to undertake new tasks and add new tasks without disrupting the structure of our work-flow. I think it provides a very structured and easily digestible framework for knowing who does what within your team."

4.2 Opinions on the existing training methods of SAFe

1) SAFe classroom-based training is overwhelming
Attendees of the training felt that there was an overload of information. Additionally, as a result of the quantity of material, our findings showed participants had difficulty in remembering and recalling the information taught. Discussing this issue, an interviewee said:

"sometimes it was really overwhelming with all the knowledge that we had to collect"

2) SAFe classroom-based training is not viable as-is during COVID-19

As SAFe training is normally run in a classroom, participants raised many concerns surrounding the feasibility of training on SAFe with the existing training method due to government travel restrictions and social distancing. As acknowledged by participants, this issue is occurring across the education sector and not isolated to SAFe training. However, when discussing the possibility of a remote distance classroom learning, participants demonstrated concerns around the interaction and engagement levels which would result. One individual explained:

"It would definitely be less interesting to do the classroom training remotely like through like a call, because, I mean, it's even harder to ask a question [...] It's easy to stay quiet, I guess, sometimes when you're in a call as opposed to being in person."

Another commented:

"I definitely feel like the remote aspect of it is quite tough. [...] Definitely is very hard to keep them engaged and keep people attentive when they're only sitting on their own in a room very far away from the actual training."

4.3 Opinions on the role and benefits of PlaySAFe

1) PlaySAFe was engaging and interactive

Research participants referenced that PlaySAFe was both an engaging and interactive learning tool. The results showed that participants varied in the game elements which they found such engagement and interactive.

- **System/ Leader-board:** PlaySAFe includes a scoring system and leader-board and therefore participants were competing against their colleagues. The game awards points for the completion of challenges and the correct answer to quiz questions. Participants felt the added element of competition is a motivation for trainees to pay more attention and have more interest which subsequently results in a better learning experience. Additionally, participants said the "instant gratification" of receiving points continuously increased game enjoyment. One participant commented:
  "[...] your also answering questions to get points, which meant that at the end of the day, you're kind of competing to be on top of a leader board and stuff, which means you've a bit more of an invested interest into it"
- **Challenges and Quizzes:** PlaySAFe consists of multiple challenges to gain points. After learning about a SAFe ceremony such as a "Retrospective", participants competed in a challenge to build on the theoretical knowledge obtained. As illustrated in Figure 3, participants took a quiz about the ceremony having completed the challenge. Participants found that these challenges made the game more interactive and contributed positively to the learning experience. Commenting on the interactivity of the game, one interviewee said:
  "[...] you actually are attending a daily scrum. You are moving stuff around, you are actually working on something. Even if it's just a simulation, but you are working on something, making a design, and then you attend a system that will give the demo and then you do the retrospective."
- **Graphics/Visuals:** PlaySAFe was developed using the Unity 3D Development Platform using high-quality materials to simulate a real-life office environment as shown in Figures 1 and 2. Such efforts to replicate the workplace were appreciated and acknowledged by many research participants. One participant commented:
  "I think the fact that the visual and graphics were very good. It was cool to see, kind of, you being a robot, walking around an office, so, like, you could relate to being in an office environment. But it was also very visually appealing."

2) PlaySAFe as a complement to SAFe classroom training

While some research participants believed the game alone would provide enough of an understanding of SAFe, most felt that it would be best utilized as complementary training to SAFe classroom training. The rationale for this varied but all perspectives can be categorized within the following groups:

– **Timing:** Individuals may join an organization and not be able to attend the classroom training immediately due to logistical or scheduling reasons. Research participants believed having an "on-demand" training was important to allow an organization to give trainees an overview until the classroom training is available. As explained by one interviewee:

"[...] it's just the classroom-based has to be scheduled and it might not happen for another four months but then you're operating within a SAFe framework for four months without fully knowing what the framework is. So I guess with the game, you have the advantages of that. Like for newcomers, like you don't have to schedule and then make sure you fit in with the schedule. You can just do it on demand."

– **Volume:** PlaySAFe has less theoretical material than the SAFe classroom training. Participants felt a blended learning approach would be beneficial so that trainees could get a high-level overview through PlaySAFe before attending the classroom-based training. Participants believed this would result in trainees feeling less overwhelmed by the vast quantity of material at the classroom training. Discussing this idea, an interviewee said:

"I think that PlaySAFe, it would be really good for someone just landing at the company, they need to know how to operate these systems and the basics of SAFe. And then they can have that knowledge and a basic understanding and then they can go to the SAFe training and really expand their knowledge on a specific subject that they are curious about."

– **Combination of practical and theoretical:** During the interviews, many participants discussed the quantity of theory that exists in the classroom training. However, participants also discussed that PlaySAFe proved as a strong complementary tool due to its "hands-on" nature. Subsequently, research participants believed that this combination of both training methods would be a good match. As one interviewee put it:

"Definitely the classroom-based has a lot of the theory behind everything, but it lacks the practical element slightly, whereas the game has probably a little less theory involved, but actually allows you to put it into practice, so I think combining the two is a good way of getting that sort of balance."

3) PlaySAFe fosters a sense of "presence" during COVID-19

As a result of COVD-19, the game-play and interviews took place at a point when research participants had been working from home for four months. Some research participants noted that the return to an office environment, even though virtual, was an interesting concept. It was explained that to have the sense of being in an office again made the game more engaging. Moreover, it was observed that this would be beneficial for newcomers to have a sense of the location of the ceremonies as this is not identifiable from a remote perspective. For example, when commenting on what made PlaySAFe enjoyable, one interviewee observed:

"[...] and also like having some level of interactivity or kind of like seeing like... "being present", I think the SAFe training game you have here kind of goes some way to get back some of that feeling of presence"

4.4 Suggested enhancements to PlaySAFe

1) Role-specific game-play
As discussed in the literature review section, SAFe consists of many different roles such as the Product Owner and Scrum Master. While these roles are theoretically discussed in the game, research participants suggested that the ability to select the "role" in which you would play for the game would allow individuals to enhance their understanding of the role. Moreover, the opportunity to "play" such roles would allow individuals that are not in this role the opportunity to get a better understanding of other roles within the organisation. Outlining this concept, an interviewee said:

"You can see this game as a nice platform for them to be in their shoes and see what their job is. So like, it would have been nice for me to play at least two or three roles in like in which I could be a scrum master or I could have been a PO taking like clients requirements and be a scrum master facilitating everything or be a QA to understand and test stuff [...] so that people have a holistic view of what everyone's role is and how they perform that."

2) Character interaction
Given that PlaySAFe is currently a single-player game, participants believed that a multi-player functionality or ability to "interact" with other game characters would enhance the enjoyment and interactivity of the game. It was suggested that this could be a bot or a colleague also playing the game. As one interviewee explained:

"So you could have different people that you interact with. So your Scrum Master, your Product Owner, your Business Owner, your Release Train Engineer, etc. And just like have a quick conversation with them and then say they might ask you a few questions or whatever and you can answer back to them."

3) Character emotion
PlaySAFe's characters are robots and do not show emotion. Participants believed that the addition of emotion to the characters would increase the enjoyment of the game and subsequently contribute positively to the learning tool. Commenting on how PlaySAFe could be improved, one of the interviewees said:

"I suppose you could have added [...] a more celebratory sign when you earn points or like the robot, looking sad when you miss a question or something like that would have been kind of funny and [...] improve engagement."

4) Team dependencies
SAFe Agile Release Trains often consists of many teams all working on the same features and therefore have dependencies on each other. This involves significant communication and collaboration. As train-level communication is not currently part of the game, many participants suggested that adding interaction with other teams regarding dependencies would improve a trainee's comprehension of SAFe. Explaining this point, an interviewee said:

"I guess having [. . .] a bit where you say, oh, by the way, [. . .] there's another team planning this feature. So, we might need to talk to them about it and kind of going through that process in terms of getting a better understanding."

5   Conclusion

As pressure mounts on software organizations to deliver software quickly to their consumers, more organizations are implementing agile frameworks. Software development organizations should invest in the trained community of developers to maintain social capital [29]. In addition, prior studies have highlighted the importance of the adoption of novel work practices [30]. Concurrently, as we see changes in how training is being deployed throughout COVID restrictions and perhaps beyond, individuals and organizations must turn towards more intuitive and remote training solutions.

Despite its exploratory nature, the present study has offered a preliminary framework for creating PlaySAFe, i.e., SAFe training in an interactive 3D environment. It has gone some way towards enhancing our training capabilities on the Scaled Agile Framework's various aspects. Notwithstanding the relatively limited sample, this work offers valuable insights for interactive virtual training. The participants took part in a semi-structured interview whereby they discussed their experiences of both training methods. Findings showed that these students of Agile Frameworks found the classroom training to overload information and be excessively theory-based. Pertaining to the digital game, PlaySAFe, participants found that it was practical, interactive, and engaging, attributed to the quizzes, challenges, and scoring system.

Moreover, participants discussed the importance of having a strong understanding of SAFe within an agile team and the role which PlaySAFe could fulfill in SAFe training in the future. They believed that PlaySAFe is best suited as a preliminary game for newcomers to an organization in advance of their SAFe classroom-based training. Such a complementary tool will allow newcomers a quick and efficient means to learn and understand the groundwork of SAFe before learning more advanced concepts in the classroom-based training.

Although the study has successfully demonstrated that several key industry advantages result from a blended learning approach for the SAFe training, including more engaged trainees who hold both practical and theoretical knowledge about the SAFe. However, with small sample size, caution must be applied, as the findings might not be directly transferable to other settings. For future work, research participants suggested that PlaySAFe could be enhanced to include more aspects of SAFe such as team dependencies. Furthermore, participants believed interaction such as multiplayer and character emotion would further improve the proposed framework.

Acknowledgments

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