SUSS | IAL — INSTITUTE FOR ADULT LEARNING SINGAPORE

PRACTITIONER'S NOTE

Leveraging Productive Failure to Deepen Adult Teaching and Learning

Results from a Pilot Study by IAL
January 2024

Presented to you by the IAL Productive Failure Project Team

Introduction

In the evolving landscape of adult education, conventional teaching methodologies often fall short in leveraging learning to support adult learners in dealing with the multifaceted challenges they face. The concept of Productive Failure (PF), an innovative learning approach, has emerged as a promising alternative. This overview aims to unpack the Productive Failure approach in overcoming specific learning challenges in adult education, and its inherent advantages and applications in varied contexts, with insights derived from the PF pilot study conducted in 2022 and 2023 with eight adult educators (AEs) from diverse sectors such as Healthcare, Built Environment, Early Childhood Education, Training and Adult Education and Security.
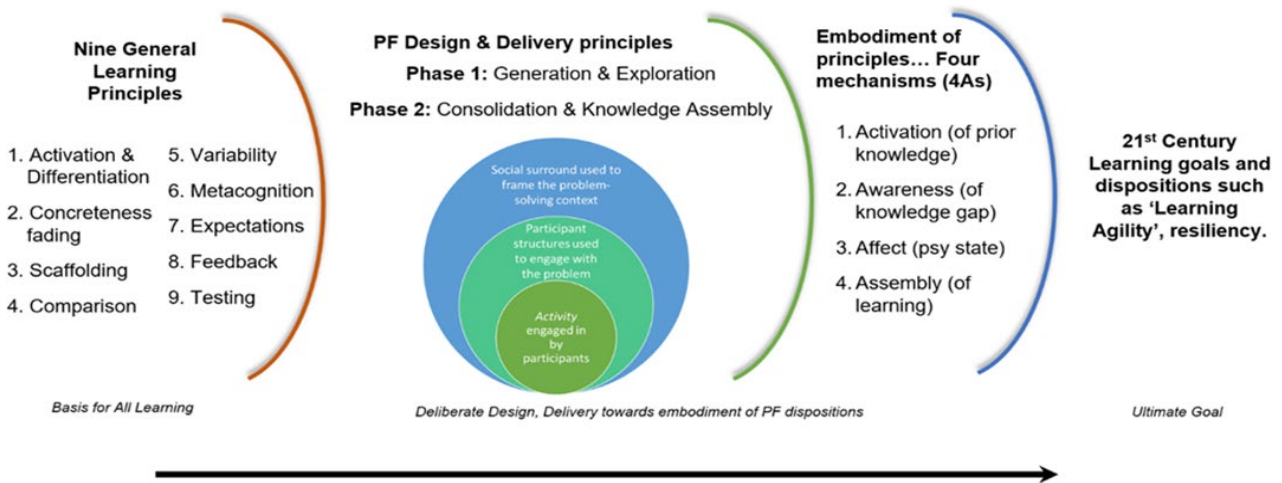
What is the Productive Failure Approach?

Productive Failure[1] embodies constructivist principles, *where failure is deliberately designed into the learning, to imbue learners with resiliency and learning agility*, skills needed for future jobs transformed by new technologies (World Economic Forum[2], 2020). The PF learning environment is designed deliberately to provide learners with the opportunity to innovate solutions while exploring complex and novel problems. Learners engage in solution construction triggered by the problem presented in phase 1, followed by knowledge assembly to build their understanding underpinned by their solution construction experience in phase 2. See Figure 1 below for more details.

[1] As detailed by Kapur & Bielaczyc (2012), PF has a two-phase design: a generation and exploration phase (Phase 1) followed by a consolidation phase (Phase 2). [Kapur, M., & Bielaczyc, K. (2012). Designing for Productive Failure. *Journal of the Learning Sciences*, *21*(1), 45–83. https://doi.org/10.1080/10508406.2011.591717]

[2] World Economic Forum. (2020). Why we need a global reskilling revolution. World Economic Forum Annual Meeting, 1–6. https://www.weforum.org/agenda/2020/01/reskilling-revolution-jobs-future-skills/

Figure 1. Illustrating the relationship among the nine general learning principles, the PF model, and the four mechanisms (4As), culminating in 21st century learning goals and dispositions

What Learning Challenges Require a Learning Approach such as Productive Failure?

Adult learners encounter unique challenges in learning as they come from varied educational backgrounds, possess different rates of learning, and need for immediate practical applicability of concepts. According to Prof Kapur, (2016), Productive Failure (PF) is a learning design that encourages learners to generate solutions to a novel problem that involves a concept they have not learned yet, followed by consolidation and knowledge assembly where they learn the targeted concept. Because learners have not learned the concept, and further, are asked to generate solutions with little cognitive support or scaffolding, they are expected to use their prior knowledge to generate sub-optimal or even incorrect solutions to the problem. With this approach, learners then work with their peers and the facilitator to review their generated solutions and the underlying constructs to align with the theoretical frameworks and concepts shared in the subsequent instruction that follows. A critical feature of PF is therefore not to provide cognitive guidance or support during the generation and exploration phases. To achieve the learning outcomes, the adult educator needs to design the task, activity, and social surround to facilitate the conduct of the PF approach, often closely calibrated with the needs of each group of learners.

Desired outcomes from the use of the design principles (DPs) in the Productive Failure approach:
- strengthen conceptual connections within the content areas.
- deepen learning (e.g., application and transfer of learning to diverse and different contexts); and
- develop learner adaptive capacity through generative and exploratory learning.

This approach is particularly beneficial in scenarios that demand complex problem-solving, the development of critical thinking, and adaptive learning strategies (Sinha & Kapur, 2021). For instance, in areas like emergency response training in Healthcare and Security, adult learners benefit from grappling with real-world problems in a controlled environment, allowing them to experiment and understand the consequences of different actions. The PF methodology illustrates its effectiveness in enhancing

problem-solving skills in such high-stakes scenarios as adult learners develop their creative solutioning skills and metacognition.

The Design Principles: Activity, Participation Structure & Social Surround

During the lesson design and implementation process, three design principles (Activity, Participation Structure and Social Surround)

guide the AEs how to apply the PF approach, according to the following respective phases:

- Phase 1: The learners engage in creative solutioning to generate outcomes based on their own experience, prior to any theory-building by the AE.

- Phase 2: The learners construct their understanding through consolidation efforts by their peers and AE to draw together key learning based on the outputs from phase 1.

Table 1. Showing the design principles across the two phases for PF-Infused lessons

Design Phases	Activity	Participation Structure	Social Surround
1. Exploration & Generation	Design and conduct activities that are adequately complex with variant-invariant features to bring about failure in problem-solving, engaging and drawing on learners' experience.	Facilitate collaboration among mixed-ability groups to explore solutions and generate thinking and reflection	Set up a safe environment for learners to explore and generate by setting expectations of conduct underpinned by socio-emotional support
2. Consolidation & Knowledge Assembly	Compare and contrast learner-generated ideas and distil into critical principles or content for assimilation.	Facilitate group discussions and presentations with learner engagement and generation of solutions to arrive at critical features.	Create a safe space for learners to review, improve and learn from the generated solutions and representations without fear of judgment.

For AEs intending to apply PF to their instruction and learning design, do bear in mind that the outputs from the problem-solving activities in phase 1 should drive the consolidation process in phase 2. To put it simply, the quality of the learning in phase 2 depends on how able the learners are in exploring and generating their own solutions in phase 1.

What are the Advantages of the Productive Failure Approach?

PF offers numerous advantages in the context of adult education. These include enhanced engagement, development of critical thinking,

resilience in the face of uncertain outcomes, and a deeper understanding of the subject matter. By presenting learners with complex problems before providing direct instruction, PF encourages active exploration and self-directed learning, resilience in pressing forward with trialling different ideas and solutions, thereby, fostering a deeper grasp of underlying concepts through self-discovery.

One significant advantage of PF is its ability to cultivate resilience and adaptability, traits that are particularly valuable in adult learning environments. Learners need to suspend judgment and patiently explore the challenges and issues before the theoretical construct is presented to them. This "experience" before

"theory" approach facilitates deep learning and connection with workplace application.

In the pilot study, the lessons which were observed employing PF strategies (e.g., early childhood teacher training, facilitation skills, emergency response competencies and other skill-based tasks) demonstrated positive learner outcomes (based on interviews and surveys with the learners). Learners were observed to exhibit behaviours corresponding to critical analysis and application of knowledge across contexts.

> Learner (Early Childhood Course, pilot 01):
>
> It's like a student-led session or rather student discovery session (for AE to) gives us a task and then as we discuss about it, as we discover it and then after that, we went around to talk (to) other groups and then after that, we could defend our own thoughts … that kind of bouncing off ideas … it created a richer discussion because of that.

> AE (Adult Education, pilot 01):
>
> It's important to make sure that in social surround, to consider the design principles for social surround and how to be creative, that safe space and generate them get into explore. So, we must allow encouragement, but more importantly … (the role of the) facilitator is to set the stage right.

What is of particular importance is the increase in metacognitive awareness of the beliefs and assumptions that they hold toward the skill or concept. For example, the learners in the Coaching 101 lesson realised that coaching by instructing their coachees is less effective than facilitating the process for their coachees to work out the reasons and solutions themselves.

Case: Utilising PF Approach in Coaching 101 Lesson

The class of 12 Healthcare professionals engaged in three rounds of coaching with each scenario presented being more complex than the previous (e.g. coaching peers to coaching superiors to providing feedback to a defensive colleague on his poor job performance).

Exploration & Generation

- In groups of three, learners discuss, and conduct role plays to coach their group mates based on the scenarios without knowledge of the coaching protocol or steps.
- Key learning from each coaching simulation was documented and shared among the groups as they explored the coaching concepts, with little theoretical exposition from the facilitator.
- With each ensuing round of coaching, learners generate the solutions and unpack the coaching constructs themselves, reviewing the key issues and reasons related to coaching.

Consolidation & Knowledge Assembly

- The facilitator extracts the key coaching principles from the earlier discussions and deepens the learning by linking the principles to the coaching framework (in this case, the GROW model).
- Learners are encouraged to make sense of the learning by linking their own insights to the theoretical framework presented.
- Closure of the lesson by emphasising application of the concepts to their work contexts

Correspondingly, throughout the entire PF process, AEs need to be mindful of the learners' internal struggles and provide support to ensure learner success even if they may struggle at the start.

The goal is to develop the meta-competencies and capabilities such as learning agility, resilience, and adaptability, preparing learners for the future work landscape of change and transformation, while at the same time, ensuring learner success at the end of the learning process.

Insights from the PF Pilot Study

Across the two phases of the PF pilot study, the AEs had the opportunity to prototype and test their lesson designs twice. Notably, the second lesson yielded better outcomes from all AEs involved compared to the first lesson, primarily due to the AEs addressing the gaps observed in the first lesson. The key insights gleaned from the two rounds of lesson observations include:

▶ Incorporating sufficiently diverse scenarios for learners to compare and contrast the issues and solutioning to arrive at the key concepts for themselves.

▶ Designing complex problems pitched at the right level of difficulty for the learners based on their profile and experience in the subject matter.

▶ The exploration of the problem followed by the generation of solutions requires careful facilitation and time to ensure positive outcomes aligned with the theoretical construct for consolidation of learning. It entails scaffolding the process through reflective questions and sufficient signposting.

▶ In-depth deconstruction of the ideas generated and assembling of knowledge to allow learner assimilation of the critical features

▶ Learner explanations and outputs should be leveraged sufficiently to distil the critical features, linking learner reflections and experience to the concepts for learning.

▶ Psychologically safe[2] environments lead to quality learner outputs as learners can explore and generate ideas with liberty and confidence.

▶ Learners need to interrogate their ideas deeply to distil the critical features and arrive at the key principles.

▶ Ensuring constructive alignment (Biggs, 2003) of learning outcomes, learning and assessment activities in both design and enacted curriculum is a baseline requirement for PF lessons.

Key Considerations When Applying PF Design Principles

A template (table 2) has been designed to facilitate reflection with questions for the AE developer/designer to determine how to incorporate the activities to bring about the expected responses. Here, we outline the key considerations that AEs need to be mindful of when implementing the PF design principles. These were the critical elements gleaned from the lessons that AEs learned based on their applications of the PF approach over the two pilot runs – pilot 01 and pilot 02. We have separated these considerations into four parts according to the sequence of lesson design and implementation:

a. Aligning the Parameters: AE, Learner, and Content
b. Phase 1: Generation and Exploration

---

2 Edmondson, A. (1999). Psychological safety and learning behavior in work teams. *Administrative Science Quarterly, 44*(2), 350-383.

https://www.proquest.com/scholarly-journals/psychological-safety-learning-behavior-work-teams/docview/203964176/se-2.

c. Phase 2: Consolidation and Knowledge Assembly

d. Evaluation: Learning and Performance Outcomes

The PF principles of Activities, Participant Structure and Social Surround (in the header of the lesson template) frame the design of the lesson plan. The two phases: 1. Generation and Exploration, and 2. Consolidation and Knowledge Assembly will inform the sequencing of the activities over time as learners explore challenges and generate solutions, leading to the consolidation of understanding by the learners. The phases are important and sequenced in this manner to drive deep learning.

My Journey with Productive Failure

From confusion to clarity, and on to commitment – that summed up my journey when I was learning to use the Productive Failure approach in my lessons. I struggled initially, firstly to grasp the key concepts such as Generation, Exploration, Compare and Contrast, and Consolidation and secondly, to conduct the highly facilitated learner-driven lesson. While I am not a novice AE, I did find PF unfamiliar in sequencing problem-solving before instruction. For my adult learners, I had to convince them to trust the process and work through the issues to arrive at the solution. Several learners were frustrated when they did not know how to begin the role play that I assigned to them to complete, simply because they did not know the steps. They had not been taught. With doubtful eyes and reluctant hearts, some did attempt to work through the role play.

Once the learners embarked on the role play despite their apprehensions, the energy and enthusiasm took over and the learners did not let the lack of understanding stop them.

In fact, they were creatively generating new steps to reach the outcome the best they could. I was stunned to see the output of their trial and error. Many groups made decent attempts and even if they fell short of excellence, their output was commendable. Even more so, their endeavouring spirit was inspirational. I was blown away when one group could uncover some of the key steps themselves without being taught specifically. Another group could through their self-reasoning and logic, figure out why and how they needed to perform the task using other ways. Amazingly, their approach could really work in real life. In all fairness, the learners worked through the problem themselves and arrived at the solution in good time with reasonable outcomes.

Subsequently, I consolidated the learning by assembling the concepts suggested by the groups, linking their learning with the theoretical constructs. In this case, learners debated their actions, defended their decisions, and actively voiced their thoughts to deconstruct their learning experience and my role was to direct their attention to critical concepts to facilitate deep learning.

I learned an important lesson during this PF session – I can give more credit and autonomy to my learners, to let them drive their own learning and co-construct their knowing. With peer support and a carefully designed lesson, my learners can benefit from the PF experience, especially when learning a key concept for the first time. The journey they undertake makes the learning a lot stickier and is more life-transforming than any presentations that I can make.

I guess you can call me a die-hard fan now!

Table 2. Template to support the application of PF to learning design.

Context: (e.g., Organisations / Sector / Purpose of Training)
Intended Learning outcomes:
Threshold/Difficult Concept:
Issue/Challenge/Problem to be solved:
Potential Errors:
Task to drive cognitive dissonance:
Learner Profile (e.g., experience, cognitive, emotive and sociality levels):

Time / Duration (min)	Lesson Plan (Activities)	How are the DPs for Activities designed & delivered to achieve the purpose of the Activities? How are these related to the 4As*? Which learning principles have been infused?	How are the DPs of Participant Structure activated in the activities? How are these related to the 4As? Which learning principles have been infused?	How are the DPs in Social Surround used to sustain the activity and participant structure? How are these related to the 4As? Which learning principles have been infused?	What are the intended outcomes in using PF? State perspectives of the learner and AE.	Comments / Resource
Phase 1:						
Generation & Exploration						
Phase 2:						
Consolidation & Knowledge Assembly						

*4As - Activation (of prior knowledge); Awareness (of knowledge gap); Affect (psychological state); Assembly (of learning).

Conclusion

The application of PF in adult education is diverse and spans various contexts. In Coaching and Leadership training, for example, PF allows learners to explore different strategies and learn from their failures, leading to more robust and well-rounded skill development. Similarly, in technical courses like First Aid or Emergency Management, learners initially confront scenarios that challenge them to apply their knowledge without guidance, resulting in a deeper understanding of principles and techniques during the later phase of consolidation.

The utilisation of Productive Failure within the context of adult education reveals its potential to transform learning experiences. By framing challenges and failures as essential components of the learning journey, PF equips adult learners with the necessary skills and mindset for effective and lifelong learning. Based on the insights of the pilot study on PF over the past two years, this pilot study underscores the versatility and efficacy of the PF approach across various learning scenarios, and advocates for its broader adoption in the field of adult education.

References

Biggs, J.B. (2003). *Teaching for quality learning at university* (2nd ed.)*.* Buckingham: Open
    University Press/Society for   Research into Higher Education.

Edmondson, A. (1999). Psychological safety and learning behavior in work teams. *Administrative
    Science Quarterly, 44*(2), 350-383. **https://www.proquest.com/scholarly-
    journals/psychological-safety-learning-behavior-work-teams/docview/203964176/se-
    2**

Kapur, M. (2016). Examining productive failure, productive success, unproductive failure, and
    unproductive success in learning. *Educational Psychologist*, *51*(2), 289-299.
    https://doi.org/10.1080/00461520.2016.1155457

Sinha, T., & Kapur, M. (2021). When problem solving followed by instruction works: Evidence for
    productive failure. *Review of Educational Research*, *91*(5), 761-798.
    https://doi.org/10.3102/00346543211019105

Publisher's note

Innovation Centre, Institute for Adult Learning

The Innovation Centre houses inlab, the one-stop touch point to catalyse learning innovation in Singapore's Training and Adult Education (TAE) sector. An initiative of SkillsFuture Singapore and managed by the Institute for Adult Learning (IAL), inlab is where the TAE sector comes together as a community to explore and innovate learning solutions.

For more information on how PF can be infused in your teaching and learning design, please visit www.ial.edu.sg/innovation/pf for the full report.

Address
11 Eunos Road 8
#07-04 Lifelong
Learning Institute
Singapore 408601