Productive Failure Application in Adult Learning: Benefits and Challenges

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Abstract
This paper draws on both Adult Educators' (AE) observations of and learners' experiences with the Productive Failure (PF)-infused lessons. In applying the PF Design principles (DPs) to lessons for learners from various sectors, this paper elaborates on the benefits and challenges faced by both AEs and their learners. Seven AEs from different sectors, e.g., healthcare, early childhood, security, professional development, participated in this project with about 150 learners involved in two pilot lessons. With the advice and support of the inventor of PF, Prof Manu, the AEs went through two iterations of designing PF lesson for two different batches of learners. Both surveys and semi-structured interviews were employed after each pilot lesson to understand the experience of PF by AEs and their learners. The project can be considered a success where The benefits and challenges as identified by both AEs and learners provide us some recommendations on how we can better support the Training and Adult Education (TAE) sector when they are incorporating PF DPs in their own teaching contexts.

Keywords: Productive Failure, Adult Learning, Professional Development

Introduction

What is Productive Failure?

Productive Failure[1] embodies constructivist principles, where failure is deliberately designed into the learning, to facilitate deep learning and imbue learners with resiliency and learning agility. These are much needed skills as jobs are transformed by new technologies of the Fourth Industrial Revolution (World Economic Forum[2], 2020). The PF learning environment is designed deliberately to provide learners with the safe space and opportunity to innovate solutions while exploring complex and novel problems. This guided exploration also allows learners to activate and differentiate relevant prior knowledge, generate multiple representations of problems, and consolidate the knowledge and skills needed to solve "wicked" real-world problems.

PF can be considered a subset of PS-I (Problem solving followed by Instruction) that fall under the broader design paradigm of Preparation for Future Learning (PFL) (Sinha & Kapur, 2021). The central tenet of PF is that failure, when well designed, may be beneficial for learning, especially in developing conceptual understanding and transfer (Kapur, 2015; Sinha & Kapur, 2021). According to Kapur, (2015), 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 without any cognitive support or scaffolds, they can be expected to use their prior knowledge to generate sub-optimal or even incorrect solutions to the problem. However, the process can be productive in preparing them to learn better from the subsequent instruction that follows. A critical feature of PF is therefore not to provide cognitive guidance or support during the generation and exploration phase. The design of the tasks, activities and social surround is developmentally calibrated with each group of learners, through multiple iterations of pilot-testing, refinement, and implementation.

As such, the desired outcomes from the use of the design principles (DPs) in the Productive Failure approach are to:

- strengthen conceptual connections within the content areas,
- deepen learning (e.g., application and transfer of learning to diverse and different contexts),
- develop learner adaptive capacity through generative and exploratory learning.

Literature Review

In linking "transfer" in learning to "preparation for future learning" (PFL), Schwartz, Bransford and Sears (2005), argued for an expansion of the definition of transfer to include "preparation for future learning" (PFL). In the PFL paradigm, transfer is defined as the use of

[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). Phase 1 provides opportunities for learners to generate and explore the affordances and constraints of multiple representations and solution methods. Phase 2 provides opportunities for organizing and assembling relevant learner-generated solutions into canonical solutions. [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/

prior experiences to inform and improve later formal learning, as opposed to a simplistic one-to-one mapping of prior content to a new context. The idea is that we use prior knowledge to identify and frame new information, and that these "knowings" can greatly shape and improve our understanding of the new context. Transfer in PFL is therefore treated both as an experience that can foster deeper learning (that is transferring out), and as a measure of learning (that is transferring in). Transfer as a process, where accessing prior experiences and information is a practice, and thus, can and should be cultivated for more effective learning (Schwartz & Bransford, 2005).

In exploring how PFL can be incorporated into learning design Loibl et al. (2016) noted the growing interest in learning approaches that combine two phases: an initial problem-solving phase followed by an instruction phase (PS-I). This was evidenced in several recent research publications (Loibl et al. found that PsychINFO lists 11 journal papers that include Productive Failure in the title published in 2010–2014) as well as articles in mainstream publications (e.g., article in the Time Magazine: Paul, (2012). Loibl et al. (2016) further distinguished PS-I from inquiry or guided discovery learning, noting that the latter's goal is to give learners various forms of support to discover the underlying model or concept on their own. In contrast, the problem-solving phase in PS-I is not designed to facilitate the acquisition of the target concept (Kalyuga and Singh, 2015) as the concept is taught during the subsequent explicit instruction phase. By asking learners to engage in problem solving prior to being taught the target knowledge, PS-I differs from other instructional methods that offer upfront instruction followed by problem-solving (I-PS).

Kapur & Bielaczyc (2012) highlighted that there is an "incommensurability between learning and performance; that is, conditions that maximize performance in the shorter term may not necessarily be the ones that maximize learning in the longer term". Kapur (2015) highlighted findings which suggested that learners from the PF condition outperformed those from the Direct Instruction approach (DI) and guided-generation conditions on procedural fluency, conceptual understanding and transfer, that is, in spite of guidance helping learners generate better quality solutions, there was no significant difference between guided and unguided problem-solving, that is, cognitive guidance during the generation phase did not result in better learning on the post test. He suggested that a plausible reason, which is consistent with the design theory of PF, could be that both low- and high-quality solutions present opportunities to learn during subsequent instruction, especially through a comparison and contrast between learner generated solutions and the canonical solution. Another finding suggests that when learning a new concept, learners seem to learn better from their own failed solutions than those of others' although, learners are still better off trying to learn from others' failed solutions than from direct instruction absent if there is no opportunity to learn from their own failures. What learners seemed to be learning from PF is an understanding of the critical features of the concept, and why it is formulated the way it is. Simply telling and explaining these features does not seem to be effective if learners have not had the opportunity to activate and differentiate their prior knowledge and engage in the comparison and contrasting of the solutions to attend to the critical features of the concept (Kapur, 2015).

The preliminary literature review conducted to date revealed that PF in K-20 settings, is well established and grounded. This raises the question whether and how PF can be applied in the adult learning field. We believe that the lack of PF experimentation in adult learning is not due to the different ways children and adult learn. Learning is no longer just about "transfer" of knowledge and skills for direct application(s) but should include adapting knowledge and

skills to new contexts effectively and meaningfully. Adult learning therefore needs to meet this challenge to remain relevant and useful; and be a valued part of lifelong learning.

This paper will be focusing on the data collected from both AEs and learners in terms of their design and experience of PF in their respective settings,

1. What are the benefits and challenges of PF application from both adult educators' and adult learners' perspectives through the comparison of Phase 1 and Phase 2 of the application?
2. What recommendations can be provided to TAE communities on the adoption of PF in terms of its application process?

PF Design Principles

When designing PF-infused lessons, there are 2 broad phases: phase 1, generate and explore followed by phase 2, consolidate and knowledge assembly. Learners undertake different activities in both phases. In phase 1, learners leverage their prior experience with peer inputs to propose new solutions to challenging problems. Subsequently, in phase 2, learners make sense of their earlier endeavour by linking their learning with the theoretical concepts presented to consolidate their learning.

During the lesson design and implementation process, the three design principles (Activity, Participation Structure and Social Surround) guide how the AEs applied the PF approach, based on the respective phases:

- Phase 1: the learners engage in creative solutioning to generate outcomes based on their own experiences, prior to any theory-building and without intervention from the AE;
- Phase 2: the learners construct their understanding through consolidating efforts together with their peers and AE to draw together key learnings based on the outputs from phase 1.

For AEs intending to apply PF to their instruction and learning design, they may have to 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 immersed the learners are in reflecting and generating their own solutions in phase 1.

Ensuring a psychologically safe environment at the start of the lesson is key to the solution generation so that learners open up to share their thoughts and ideas. Peer learning processes empower learners to play an active role in developing new understanding, positions, and solutions to problems, facilitated by occasional interjections from the adult educator. The learners can move from an initial exchange of accumulating information to a state of knowledge co-construction. Being responsible for the outcomes from joint activities builds trust and ownership of the learning space when learners own the right to express their ideas. Sharing this responsibility promotes dialogic exchanges which can be useful to prepare learners for future work.

Likewise, learners need to be receptive to assimilate the theoretical constructs put forth in the second phase of the lesson and feeling psychologically safe is important for opinions to be voiced and accepted.

Phase 1: Generation and Exploration With Unpacked PF DPs

Activity (Complex problem)	Participation Structure (Collaboration)	Social Surround (Affective support for persistence)
• Create intuitive hooks with an affective draw • Engage students in design • Admit multiple representations and solutions • Use variant-invariant features to bring about failure in problem-solving • Use contrasting cases • Keep computational load as low as possible	• Enable collaboration in mixed ability groups • Support learners to collaborate through an appropriate macro script • Push learner thinking through the disciplinary facilitation	• Create a safe space to generate and explore ideas • Set and constantly emphasize appropriate socio norms and values <specific to your own subject/ topic> • Provide affective support for persistence

With the outputs from phase one, the AEs proceeded to consolidate their learnings for phase two. Seemingly foundational, the challenge is the variance in the learner outputs generated from phase one which required AEs to be agile in assembling these diverse points/solutions to consolidate the learning effectively and efficiently, which also implies that AEs need to possess a deep level of subject matter and pedagogical expertise especially when constrained by the lack of time at the end of the lesson.

Phase Two: Consolidation and Knowledge Assembly

In the second phase, learners in the pilot classes are given the opportunity to extract the critical features or first principles from the earlier activities, that is, learners undertake the knowledge assembly process themselves, guided by feedback from their peers. The contrast in the learner outputs within and among the groups in phase 1 facilitates the theory building in phase two.

The facilitation by the AE at critical junctures of the consolidation process is also important to clarify doubts concerning the content. Hence, one AE competency is identifying the evolving learner needs and the point of interjection by the AE to effect the greatest learning impact.

Design of the Study

Figure 1. PF application Process

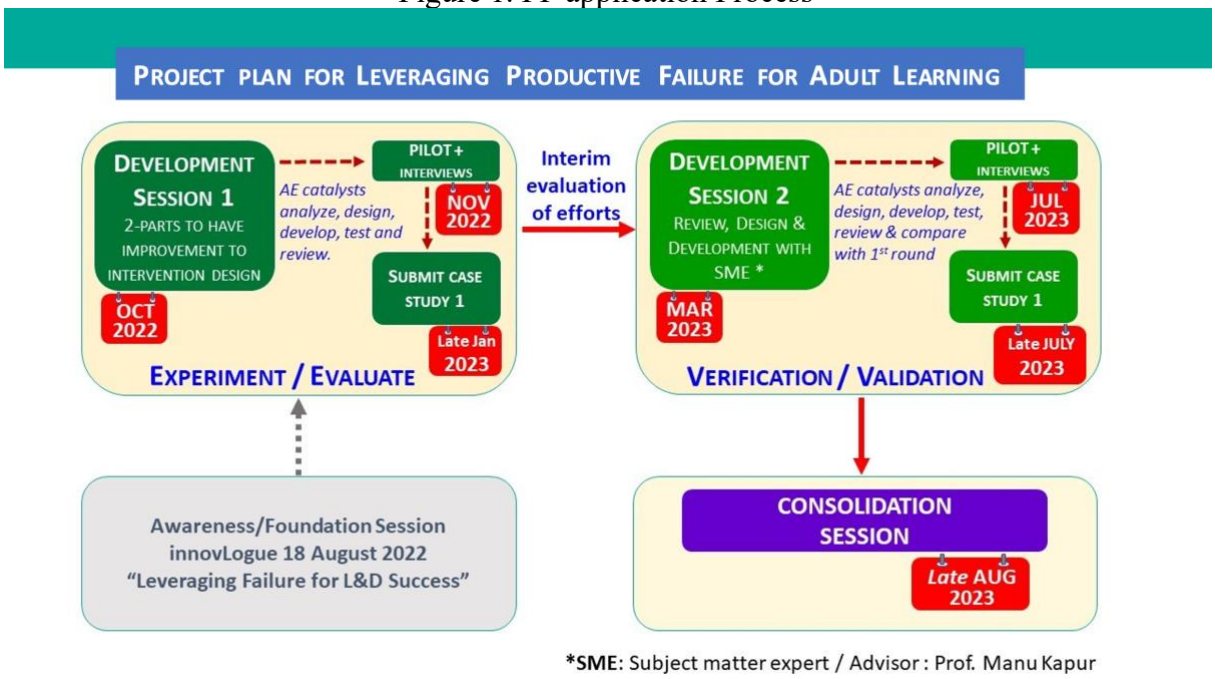


Table 1. Evaluation process for PF application

Phases on the experimentation	**Evaluation Instrument and process**
After Pilot Case 1	• Post lesson, interviews of AEs on their use of PF (input and process) • Post lesson, interview with two selected learners on their learning experiences on the use of PF in their respective classes • Post lesson, survey for learners on their learning experiences on the use of PF in their respective classes • Observation of AEs and learners in their own classes
After Pilot case 2	• Post survey on AEs' understanding and challenges of using PF in their contexts own teaching context (Input and process) • Post interviews of AEs on their use of PF (process and product) • Post interview with two selected learners on their learning experiences on the use of PF in their respective classes • Post survey for learners on their learning experiences on the use of PF in their respective classes • Observation of AEs and learners in their own classes

Using the instrument developed for the entire evaluation process, the findings are presented in the following two sections from both AEs and learners' perspectives for the benefits and challenges in applying PF in CET contexts.

Table 2. Data collected for evaluation

Industry Sectors of AEs	Pilot Case 1	Pilot Case 2
AE from Early Childhood	Learner Interview and Survey, AE interview, and class observation	Learner Interview and survey, AE interview and Survey, and class observation
AE from Teacher Training		
AE from Security		
AE from Healthcare 1		
AE from healthcare 2		
AE from TAE sector		
AE from Building and Environment		

The analysis of the data collected is to describe and make comparison between Phase 1 and Phase 2 in order to understand the challenges and benefits of PF application in different adult learning contexts. Drawing on these challenges and benefits, the team would be able to make a more objective evaluation of the PF application in adult learning.

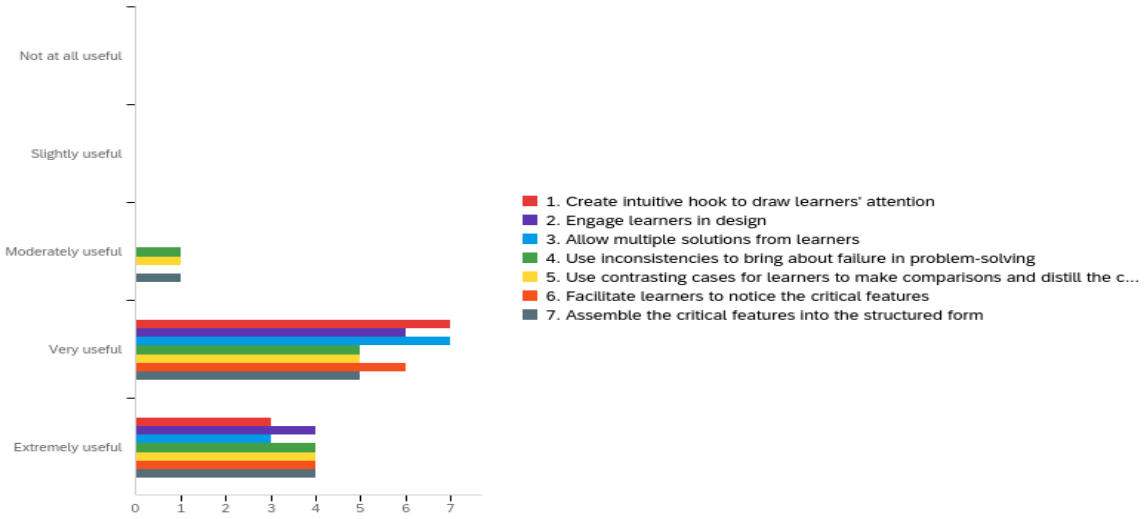
AE Survey and Learner Surveys Results for Pilot 1 and Pilot 2

AE's Profile

Most of the AEs (6 out of 10) participating in this study are falling in the age range between 41 to 50 years old, and all of them have minimum bachelor's degree or above. In addition, most of them (6 out of 10) have more than 20 years of industry experience with the course they are teaching.

AE's and Learners' Self-Perception of PF DP During Their Teaching and Learning Process

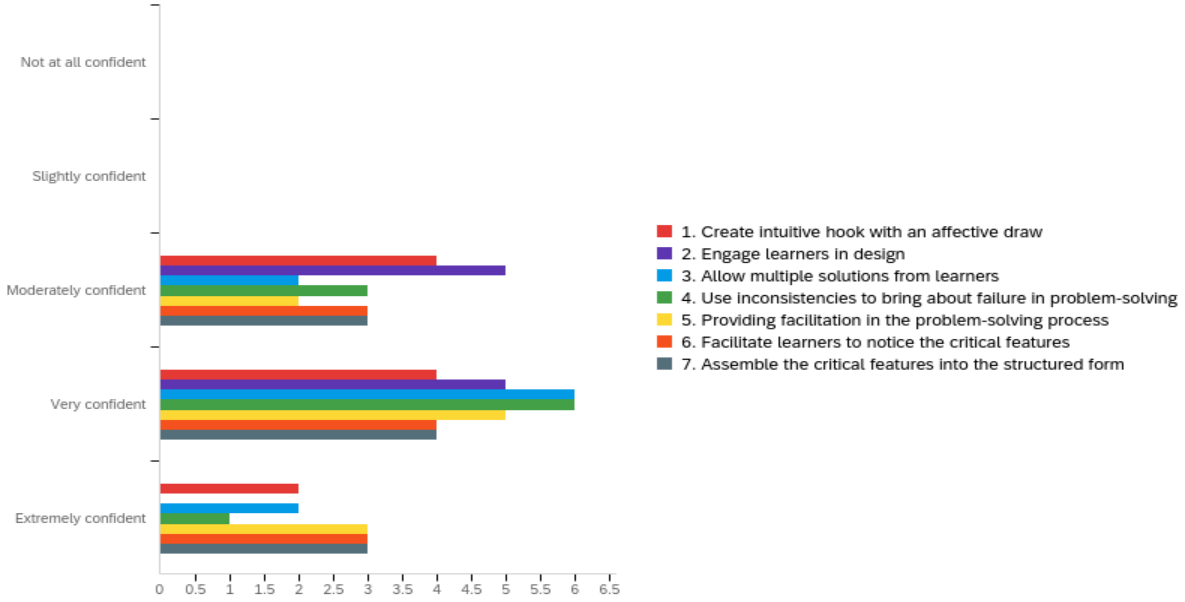
Figure 2. How useful the participating AEs were using different PF DPs for ACTIVITY?



Majority (over 5) of the AEs rated all of the seven DPs for activity as very useful. The top two very useful DPs for activity rated by most of the AEs (7 of them) are,

1. Creating intuitive hook.
2. Allow multiple solutions.

Figure 3. How confident the participating AEs were using different PF DPs for ACTIVITY?



However, when coming to the confidence level of using these different DPs for activity, most of the AEs rated the following to DPs with moderate confidence,

1. Engage learners in design.
2. Creating intuitive hook.

This finding may imply that AEs may need more training and assistance in creating the intuitive hood for learners during their own lessons as they rate it as a very useful DP for activity but they are only moderately confident in how they use it.

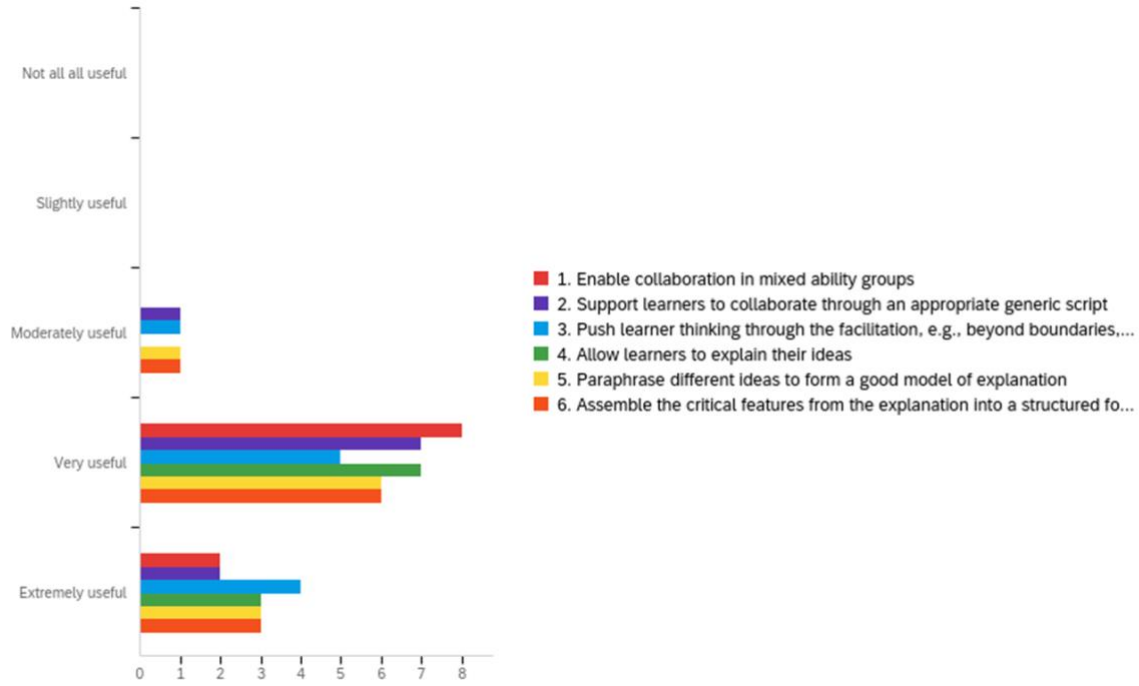
Table 3. Learner Experience of PF DPs for Activity for Pilot 1 and Pilot 2

Question	Never	Sometimes	About half the time	Most of the time	Always	Mean	SD
1. I was encouraged to challenge myself to solve the problem	0.00%	8.86%	13.92%	51.90%	25.32%	3.94	0.87
	1.35%	10.81%	12.16%	51.35%	24.32%	3.86	0.95
2. I was involved in the design of the solution to a problem	1.27%	13.92%	17.72%	40.51%	26.58%	3.77	1.04
	6.76%	22.97%	12.16%	33.7%	24.32%	3.44	1.28
3. I was encouraged to explore different solutions	2.53%	13.92%	15.19%	39.24%	29.11%	3.78	1.09
	2.7%	14.86%	20.27%	37.84%	24.32%	3.67	1.08

4. I learned from my mistakes in developing different solutions	0.00%	7.59%	17.72%	51.90%	22.78%	3.90	0.84
	2.7%	8.11%	17.57%	47.3%	24.32%	3.84	0.99
5. I was encouraged to compare different solutions to develop a better understanding	1.27%	8.86%	16.46%	43.04%	30.38%	3.92	0.97
	1.35%	13.51%	12.16%	45.95%	27.03%	3.85	1.02
6. I find it challenging to solve the problem given but feel supported to continue to do so	1.27%	13.92%	17.72%	40.51%	26.58%	3.77	1.04
	0.00%	10.81%	10.81%	51.35%	27.03%	3.92	0.92
7. I was encouraged to identify the important features of the learning content	2.53%	10.13%	11.39%	48.10%	27.85%	3.89	1.01
	1.35%	8.11%	10.81%	44.59%	35.14%	4.05	0.95
8. I was encouraged to put the important features together into a structure to form the basis of my solution	2.53%	8.86%	13.92%	45.57%	29.11%	3.90	1.01
	0.00%	12.16%	13.51%	44.59%	29.73%	3.93	0.96

Correspondingly, the AE's moderate confidence in engaging learners in design are also reflected in learners' experience in these PF-infused lessons. For learner survey item 2, pilot one and pilot two showed the lowest mean value from learners as compared with other items. Therefore, AE's moderate confidence in engaging learners in design does affect learners' experience in this DP as shown above.

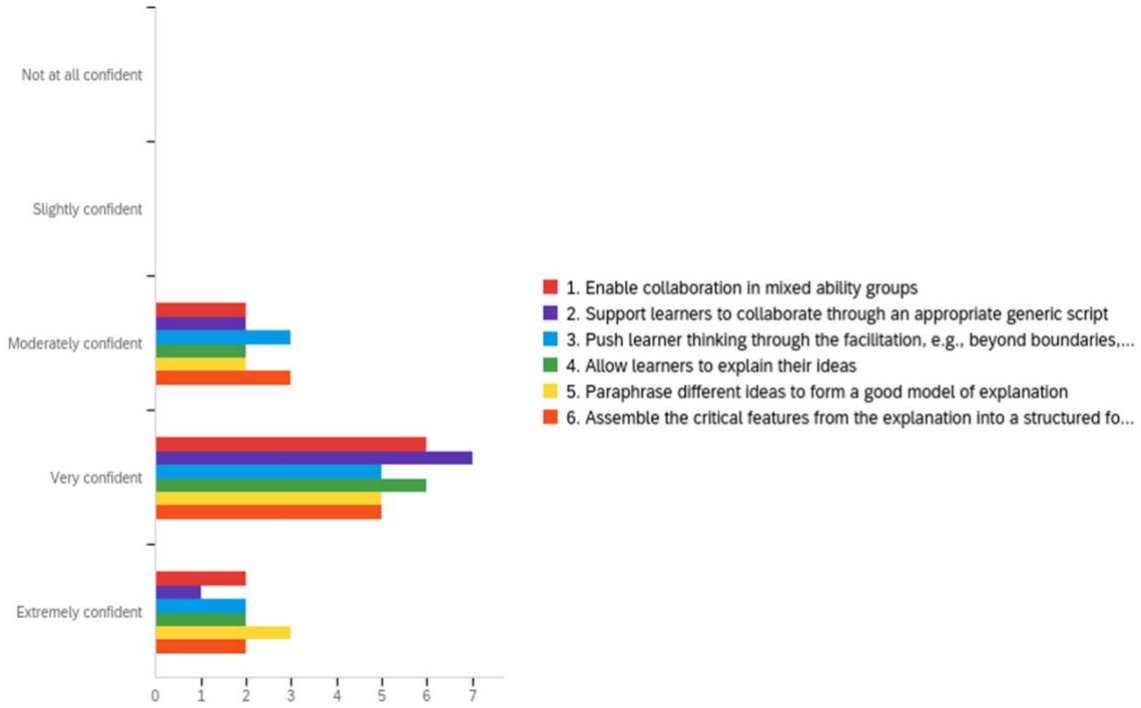
Figure 4. How useful the participating AEs were using different PF DPs for PARTICIPANT STRUCTURE?



Most of the AEs (7 to 8 of them) rated the following three DPs for participant structure as the most useful one in their PF application, Enable collaboration in mixed ability group;

1. Support learners to collaborate through generic script;
2. Allow learners to explain their ideas.

Figure 5. How confident the participating AEs were using different PF DPs for PARTICIPANT STRUCTURE?



In using these DPs for participant structure, most of the AEs (6 to 7 of them) felt they were very confident in using the three DPs that they found very useful,

1. Enable collaboration in mixed ability group;
2. Support learners to collaborate through generic script;
3. Allow learners to explain their ideas.

This finding implies that in using the DPs for participant structure, the AEs tend to be consistent in terms of their rating for the usefulness and confidence of these DPs. That is, they showed strong confidence in using the DPs they rated as very useful.

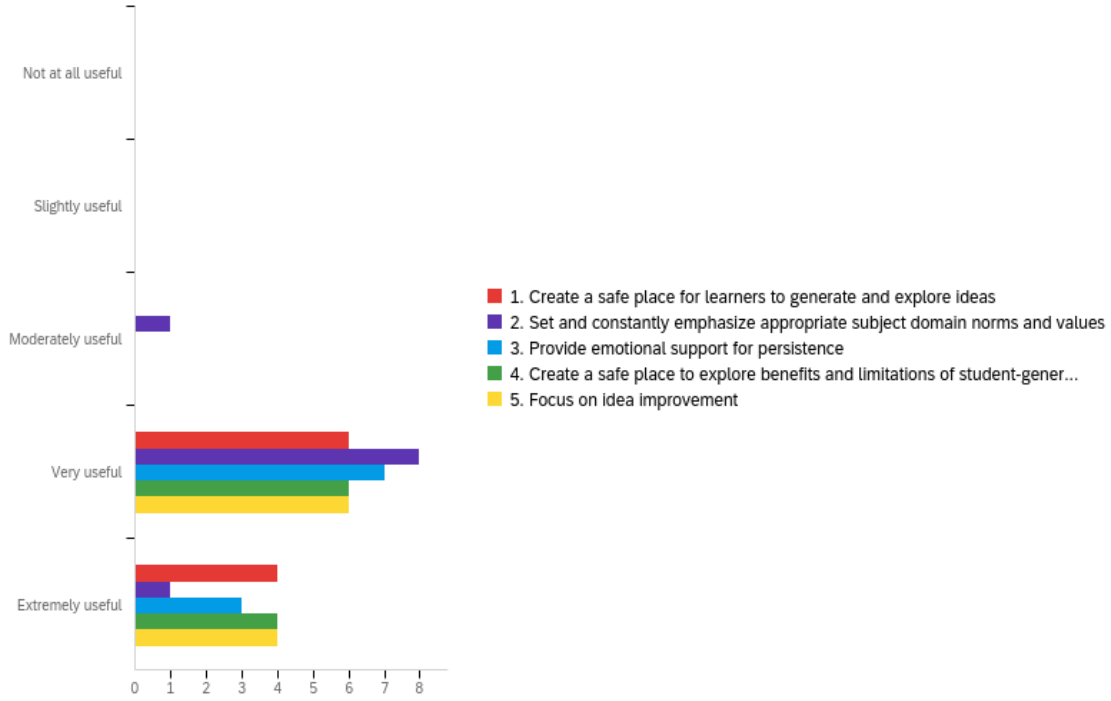
Table 4. Learner Experience of PF DPs for Participant Structure for Pilot 1 and Pilot 2

Questions	Never	Sometimes	About half the time	Most of the time	Always	Mean	SD
1. I was encouraged to challenge my fellow learners' solutions/ideas	3.85%	17.95%	20.51%	35.90%	21.79%	3.54	1.14
	4.05%	22.97%	24.32%	31.08%	17.57%	3.33	1.14
2. I was encouraged to work with other learners to find solutions/ideas	2.56%	10.26%	10.26%	46.15%	30.77%	3.92	1.03
	1.35%	12.16%	10.81%	44.59%	31.08%	3.93	1.02
3. I find it difficult to work with my fellow learners as we have very different abilities (reverse coding)	38.46%	29.49%	11.54%	14.10%	6.41%	3.81	1.03
	45.95%	32.43%	13.51%	2.70%	5.41%	4.13	1.06
4. I was encouraged to think out of the box	2.56%	14.10%	10.26%	50.00%	23.08%	3.77	1.04
	1.35%	17.57%	16.22%	39.19%	25.68%	3.72	1.09
5. I was encouraged to explain my ideas	1.28%	17.95%	7.69%	50.00%	23.08%	3.76	1.05
	2.70%	14.86%	10.81%	43.24%	28.38%	3.81	1.10

6. The trainer used and worked on our explanations to form a model answer	1.28%	11.54%	12.82%	50.00%	24.36%	3.85	0.97
	2.70%	4.05%	12.16%	45.95%	35.14%	4.07	0.93

Again, strong confidence shown by AEs are also reflected in learners' experience. For example, learners are encouraged to work with other learners quite often to find out solutions with high mean values (Pilot 1: 3.92; Pilot 2: 3.93). In addition, the trainer used and worked on learners' explanations to form a model answer very often too (Pilot 1: 3.85; Pilot 2: 4.07).

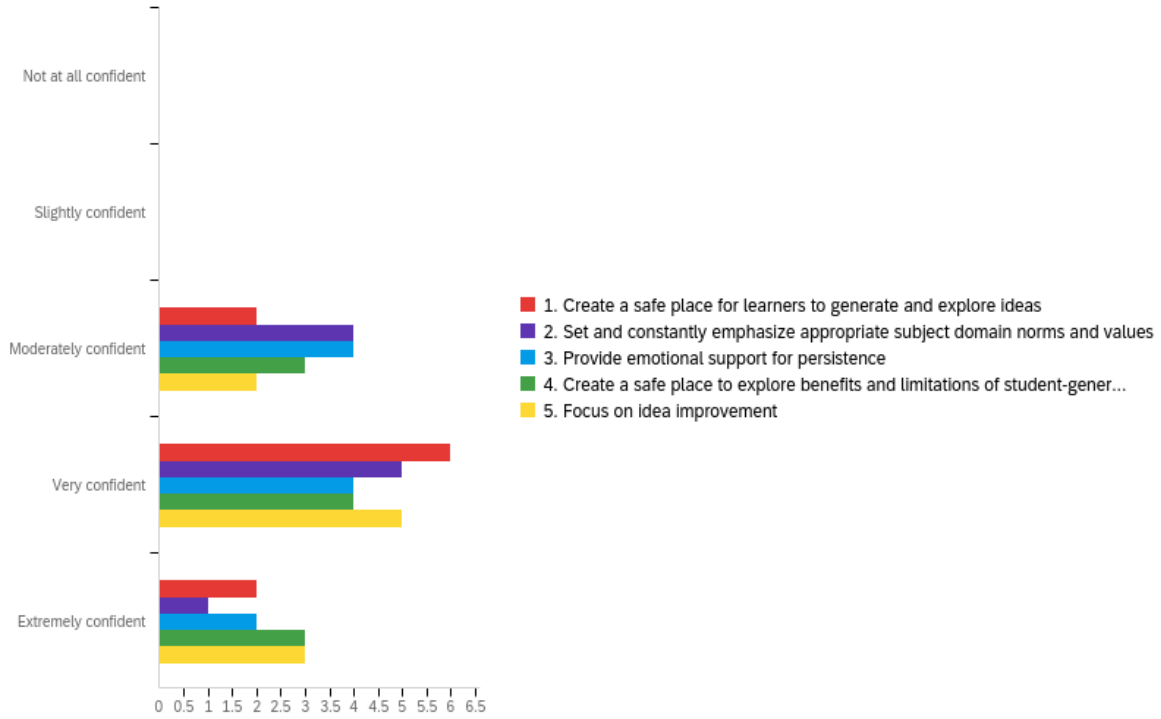
Figure 6. How useful the participating AEs were using different PF DPs for SOCIAL SURROUND?



Most of the AEs (7 or 8 of them) rated the following two DPs for social surround as the most useful DPs,

1. Set and constantly emphasize subject domain and values;
2. Provide emotional support for persistence.

Figure 7. How confident the participating AEs were using different PF DPs for SOCIAL SURROUND?



While in using these DPs for social surround, the top two DPs they felt moderately confident are,

1. Set and constantly emphasize subject domain and values;
2. Provide emotional support for persistence.

This finding implies that these AEs may need some more support in using these DPs more confidently as they rated as very useful from their application.

Table 5. Learner Experience of PF DPs for Social Surround for Pilot 1 and Pilot 2

Questions	Never	Sometimes	About half the time	Most of the time	Always	Mean	SD
1. I feel encouraged to generate and explore ideas	0.00%	7.69%	11.54%	53.85%	26.92%	4	0.84
	0.00%	9.46%	13.51%	52.70%	28.38%	3.96	0.89
2. I feel I am supported for my ongoing efforts to find the solutions	0.00%	7.69%	19.23%	47.44%	25.64%	3.91	0.87
	2.70%	5.41%	13.51%	52.70%	25.68%	3.95	0.93

3. I feel motivated to try again when my earlier solution did not work out	0.00%	8.97%	17.95%	48.72%	24.36%	3.88	0.88
	2.70%	9.46%	18.92%	43.24%	25.68%	3.8	1.01
4. I was encouraged to share my views on different ideas presented by other learners	0.00%	10.26%	12.82%	44.87%	32.05%	3.99	0.93
	1.35%	9.46%	14.96%	43.24%	31.08%	3.95	0.98
5. I was encouraged to improve my ideas	0.00%	11.54%	17.95%	38.46%	32.05%	3.91	0.98
	1.35%	9.46%	14.86%	47.30%	27.03%	3.91	0.96
6. I have the know-how to improve my ideas	1.28%	15.38%	19.23%	43.59%	20.51%	3.67	1.02
	0.00%	20.27%	24.32%	43.24%	12.16%	3.45	0.96

Again, from learners' experience, they did not feel very motivated to try again when their earlier solution did not work out (Pilot 1: 3.88; Pilot 2: 3.8), and they did not always have the know-how to improve their ideas (Pilot 1: 3.67; Pilot 2: 3.45) as compared with other DPs.

Benefits of using PF From AE's Observation

Ownership of Learning and Strong Engagement of Learners

I think one of the key things about PF is the onus of engagement. So in this case, where the participants are free to explore the sense of ownership over the gap or challenge that they uncovered, even though we identified the challenge for them, but having them being able to freely explore, to kind of identify the challenge on their own or identify gaps on their own, and to reaffirm actually pushes or places much of the ownership on their shoulders. And that way, when the discussion started, it's a lot richer, because the sense of ownership, responsibility is a lot greater (From English teacher PD session_phase 1).

Strong Engagement of Learners

I think they were very engaged. Maybe the topic was well chosen. And I think that was a key. They saw the benefits of doing those activities. *And because they clarified, so the engagement was there* (From English teacher PD session_phase 1).

So in terms of engagement, I would say that it will be similar or better than the last one. Yeah. Because I think that time the PF thing sort of like also they thought is PF workshop. So they were little confused maybe the first time we had the phase one. So that's why we had to clarify you know, it's really spiral progression that we are looking at in curriculum. So this round I would think like in terms of engagement, I would say that none of them were like a playing with your phone or, you know, like trying to or just sitting back, you know, not so involved. I think all of them were really, really trying their best to solve whatever activity that was given to them. *So the engagement was extremely high* (AE from English teacher PD session_phase 2).

Challenges Faced by AE in Applying PF DPs From Surveys

More practices may be helpful in PF application.	As this is a newly learnt model, practice will make it easier and better in any learning process. All areas are useful and will need to be mindful to look and build the components in.
To differentiate the challenging levels of DPs may be more helpful in PF application.	To clearly state which DP is more effective or challenging. I would think the DPs work together as a whole.
Creating contrasting cases is one of the DPs reported being challenging.	Compare and contrast learner ideas to distill critical features: This can be challenging, especially when our participants have a great deal of commonality in terms of professional competency, meaning it can be tough to collate different ideas required for contrast and comparison.
Time constraints, familiarity of topics chosen may create challenges for allowing multiple solutions from learners and using variant-invariant DP.	Admitting multiple representations & solutions and using variant- invariant features. Bringing about enough representations & variations within a given time constraint is a challenge that we faced.
	Multiple representations. The time for these sessions may be limited. Wondering as well, how principles of andragogy and learner motivations sit will PF. I see the benefits but the trainers must be willing to put themselves out there to address uncertainty.
Creating failure in a safe and encouraging space could be challenging.	Phase 1 Generation. This is the starting point of the PF activity and a lot of emphasis is required to create the safe space and encourage the learners to try the activity despite them being 'loss' or 'afraid' to make mistake as they are unsure on the required answer.

Learners' Reflection on Their Experience of Taking PF Lessons

Deep Understanding by Learners

> "But now, because we have to do it, I think we see more meaning in it. Yeah. We understand in a sense why we need to do it, the process and all. So I guess that experience, *we understand better as well the mechanism behind it at the same time why we do it*." (Adult learner from English PD session_Phase 2)

> "Memorable like… because we tried it out on our own and then like… there's the… a bit of vulnerability or embarrassment when we fail and picking up ourselves from that is a very interesting process also. *So, I think that was something that was quite memorable for me.*" (Adult learner from Healthcare_Phase 2)

Learner-Led Session

> "Yes. It's like a student led session or rather student discovery session. Yes. Because for AE, what she did was to you know, like give us a task and then as we discuss about it, as we discover it and then after that, we went around to talk about other groups and then after that, we could defend our own thoughts and all and say that hey this is what we think and stuff like that. *So, with that kind of discussion that's… that kind of bouncing off ideas, then it created a richer discussion because of that*."

> "Yes. So, the… so we had group… first, we had group discussion where you talk about your own things and then discuss. After you discuss, then there was intermingle of groups where you talk about different perspectives from other groups. Then you're like, "huh? What? I don't agree with what they say" or "I agree" or whatever. Then, you are able to defend yourself. So, there was many… *there were many points where we could think about our own responses.* So, it's not just I give you a question, you answer, I give you feedback. That's it. You know? Because a lot times, especially when we mark assignments right? I feel that I give all the comments right, at the end of the day, do the students actually read it? Does it actually matter?" (Adult learner from early childhood _phase 1)

More Peer Learning Generated

> "That's why just now when I shared about the affirmation, *I learn so much from others. The ideas is much better than just from my own because they have so much richness in their experience, so I learn a lot from everyone today*." (Adult learner from early childhood_phase 1)

> "*Not just to express one way, but there were different points when you could have different feedback.* So, there was feedback from your own… let's say I have my idea, then I feedback from my own group, right? Then, after we put it up, then another group comes and look at your thing. Then, they have feedback for you. And then after that at the end, you have your own feedback as well. You know, after seeing what other people written. So, there are…" (Adult learner from early childhood_phase 1)

Summary and Implications of the Findings

These benefits proves that the overall design of the project was successful which brings about above benefits for the learning process. The project started from the webinar by Prof Manu in Aug 2022 to gather the interested AEs on using PF in their own classes. After the webinar, the selected AEs attended first round of development session with Prof Manu to design their lesson plan using PF for their pilot 1 lesson. After pilot one lesson ended around Nov 2022, these AEs attended second round of developmental session with Prof Manu to develop their lesson plan with a new topic using PF DP, followed by their pilot 2 lesson with different batch of leaners for most of the AEs. Such an iteration design of the project helps AEs improve their lesson design with more intentional changes between the two pilot lessons. As shared by the AEs during their interviews and case report, they tend to be more conscious in designing PF DPs in their lessons and think ahead of the possible engagement and challenges faced by their own learners to better prepare themselves for these different spontaneous scenarios. More importantly, for those AEs who were teaching same group of learners in the two pilot rounds, the learners could benefit most from the improvement of PF DPs used by their AEs. As shared by the learners undergoing both rounds of pilot lessons, they strongly felt the smoother flow of the lesson and became more engaged and used to the challenges posed by AEs in pilot 2 lesson. However, not all of the AEs taught the same group of learners in the two pilot lessons, it would be more revealing on improvements of AE's application of PF DPs in their own contexts if the same group of learners were engaged in both pilot lessons.

Recommendations for PF Application in CET Community

The findings presented above, e.g., self-reported usefulness and confidence is using PF DPs and also the reflections from both AEs and learners regarding their experiences of PF lessons showed that PF DPs are applicable in CET contexts. Particularly, in terms of motiving self-directed learning, peer learning and higher learner engagement, PF DPs proves highly useful in the teaching contexts of various courses in CET sector. Therefore, drawing on these findings, the present evaluation study could, to some extent, facilitate the decision-making of stakeholders on proliferation and application of PF DPs in adult learning. However, in promoting the use of PF DPs in adult learning, some recommendations drawing on the challenges faced by these participating AEs may need to be taken into consideration,

1. Course content to be covered using PF DPs needs to be carefully selected to ensure the intuitive hook could be built up easily and equally with all the learners. If some learners have already been familiar with the content, if may be unlikely to be successful to apply PF DPs.

2. PF DPs themselves cannot generate the benefits as identified in this evaluation study. AEs' rich experience of facilitation skills plays an important role to enable the power of PF DPs. The evaluation study reveals that AEs with higher facilitation skills tend to apply the PF DPs more proficiently. For those novice AEs, some guidance from experienced AE maybe more helpful in applying PF DPs.

3. A prior understanding of adult learners' mindset toward learning may also need to be taken into consideration when apply PF DPs. The present evaluation study found out that if adult learners hold strong belief in passive learning, meaning downloading from AEs, it is hard to engage them in PF activities. Therefore, the open mind of adult learners to

embrace different types of learnings could be another factor to be considered before applying PF DPs.

4. Last but not the least, the duration of the courses and the frequency of the practices are important considerations for AEs to apply PF DPs. As revealed by most of the AEs from pilot one to pilot two case, longer duration of the course gave them more chances and time to practice and refine the PF DPs at the different stages of the lesson. In addition, most of them reported that they were more proficient in applying PF DPs in pilot two case.

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