

## *Reflecting on a tertiary educator's implementation of a project-based flipped classroom: A repertory grid analysis*

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*Appendix A: Second author's repertory grid for a project-based flipped classroom*

### ABSTRACT

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**Grid-based reflection:** This report outlines how the authors used repertory grid findings in their collaborative reflective practice in vocational education in a tertiary setting. Second author (SA), Dileep Rajendran, invited first author (FA), Willfred Greyling, to track his implementation of a project-based flipped classroom in an Information Technology module.

**Pedagogy:** The course design was based on the following principles associated with project-based flipped classrooms:

- **Acknowledge learners' current and potential skill:** The teaching had to be pitched at a level where learners' current competence would be an adequate stepping stone to elaborate their knowledge and skill through inquiry-based learning<sup>1</sup>.
- **Specify classroom participants' responsibilities in inquiry-based learning:** The tutor's role would be to structure inquiry-based learning projects and learning spaces where learners took optimal responsibility for their learning.
- **Design and enact learning that develops learner autonomy:** The target would be to promote learner autonomy and their ability to reason and act in the IT networking field.

**Observer interests:** The observer's interests include classroom observations as third-party accounts of interactively accomplished learning, and repertory grid use as a means to assist educators in exploring their pedagogical thinking and doing.

**Eliciting pedagogical constructs, grid design and application:** Following two classroom observations and reflective dialogues on both observations, we agreed to elicit SA's constructs for a repertory grid (see Appendix A). Following the difference method (Fransella, Bell and Bannister, 2004), we used 10 elements to elicit 10 constructs. After crafting the formulations until SA felt they best represented his meaning-making lenses, we used a 7-point rating scale in our grid design, and followed guide-lines for scale conversion, pole reversals, and reverse scoring (Fransella, et al., 2004) to enhance the validity of our process.

**Complex interactions among an educator's pedagogical constructs:** Our purpose was to unpack SA's pedagogical meaning-making at a level beyond discrete lists of bipolar constructs: we intended to show a deeper level of analysis, namely, that educators' constructs do not function in isolation, rather, they form complex patterns within the individual's meaning-making. To explore these patterns, we performed principal components analysis (PCA) and cluster

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<sup>1</sup>. This principle derives from the Vygotskian notion of the zone of proximal development (ZPD). For learners to expand current knowledge, the tutor designs learning experiences, supported by specific pedagogical strategies (such as inquiry-based projects and flipped classrooms), which will lead to mastery of new skills and knowledge (Vygotsky, 1978; Van Lier, 1996). The ZPD lies beyond current competencies.

analysis (CA) on SA's ratings which yielded two components and a dendrogram. These, together with the correlations among constructs, became prompts for making sense of the varying levels of association among SA's constructs.

**Triangulation:** Following Viney and Nagy (2012), we triangulated our collaborative account of the repertory grid findings against two classroom observations and informal input from participating students. The observations highlighted how SA implemented the principles and practices of a project-based flipped classroom, specifically the principles referred to above. We also elicited informal input from the participating learners. A selection of comments is included.

**Findings:** We found that

- the tutor's role remained significant as a designer of learning experiences and a guide to learners to develop problem-solving strategies. These strategies avoided transmission-based exchanges; rather, they consistently ensured learner engagement and learner-centred practice.
- In project-based flipped classrooms, the tutor has a significant role, designing tasks, re-defining both his own and learners' roles, as well as retaining an inquiry-based approach when barriers occur in the learning.

**Conclusions:** We concluded that our grid use

- allowed both authors to reflect on SA's implementation of a project-based flipped classroom, capturing an account of SA's thinking and doing associated with his teaching practices (classroom observations).
- gained in meaningfulness when we triangulated these findings against student perceptions which showed that although they found the learner-centred role and the tutor's deliberately limited project information (step-by-step outlines) challenging, they understood the purpose and the approach.
- exposed the tip of the iceberg: much more could be extracted from the grid, especially when the grid was transposed and elements analysed.
- identified an agenda for continued reflection, for example, how to manage the ratio of teacher mediation and learner-centred activity; and the deliberateness of tutor strategies to enact learner-centred approaches.

## REPERTORY GRID USE

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Repertory grids<sup>2</sup> are applied in a wide range of contexts to uncover patterns of meaning-making in the ratings of individuals. Developed by personal constructs psychologist, George Kelly (1955), the method has been embraced by practitioners and researchers in diverse fields such as education (Pope, 2003; Salmon, 2003), management (Brophy, Fransella and Reed, 2003), mentoring (Cromwell, 2003), strategic planning (Cornelius, 2003), cross-cultural studies (Scheer, 2003), forensics (Horley, 2003), nursing (Costigan, Ellis and Watkinson, 2003), family therapy (Proctor, 2003), police training (Porter, 2003), sport (Savage, 2003) and artificial intelligence (Adams-Webber, 2003).

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<sup>2</sup>. This is a case study similar to three other studies conducted in the organization to capture best practice (Greyling, Belcher and McKnight, 2013; Greyling and Lingard, 2015; Greyling and Waitai, 2016) in a range of pedagogical contexts. We have also shown how repertory grids can be used to develop a meta-level of analysis when case studies are compared (Greyling, 2016). It is important to note that this started out as a capability development project to explore how we could design and implement a triangulated evidence-based cycle that could be used for reflective practice at the institute.

Repertory grids can be used to identify patterns of meaning-making that obtain within a person's constructs. Put differently, the different meaning-making lenses used by an individual are not viewed as discreet; rather, they are integrated, yielding a mosaic of complex meanings typical of the individual. Thus, repertory grids are used to make explicit these complex interactions among the various lenses that an individual activates (Fransella, et al., 2004) in making sense of his or her experience. We illustrate in this report how we addressed this aim for the second author.

The repertory grid technique is used mainly with individuals, albeit that group grids may also be administered. In a 10 x 10 grid, we are working with a sample of 100 meaning-making moments for the individual whose network of meaning-making lenses is being explored. Thus, instead of focusing on the number of subjects we have included in a sample, as one would in a quantitative sample-based study, we focus on the number of ratings included in the grid.

Grids are constructed in collaboration with the individual whose meaning-making is targeted for reflection. The purpose is to assist the individual to articulate the verbal labels he associates with a specific experience. The first step is to define the focus of convenience of a grid – this would be a general statement that relates to the thematic scope and purpose of the grid. See the next section for a specific example.

The next step is to define elements to be used in eliciting constructs. Elements generally relate to significant roles or aspects that are relevant to the focus of convenience. These elements are compared, and constructs are defined as follows: two elements have to be similar (an aspect of similarity) yet different from a third (an aspect of difference). For example, two elements may refer to educator control over classroom interaction, but they may be different from the third where the educator sheds control. Thus, control is the similarity, while shedding vs taking control is the difference (Fransella, et al., 2004). Each construct is bipolar, with the poles of the construct defined in terms of such differences that relate to the aspect of similarity. For the sake of controlling the scope of a reflective study, one will select, say, 10 constructs to rate approximately 10 elements.

Standard principles of repertory grid application and processing require reversing poles in the administered grid, adopting a 5-point or 7-point rating scale, and generating ratings that are independent. After reverse scoring and converting the scale (i.e. a scale of -3 to +3 for the values in the 7-point scale), one can perform a range of statistical procedures. Some of the popular statistical procedures used include principal components analysis (PCA) to identify the factors that best explain the meaning-making relationships in the grid, inter-construct relationships (i.e. correlations) to show which constructs are associated, and cluster analysis to show how various constructs are aligned (i.e. yielding a dendrogram) (Fransella, et al., 2004).

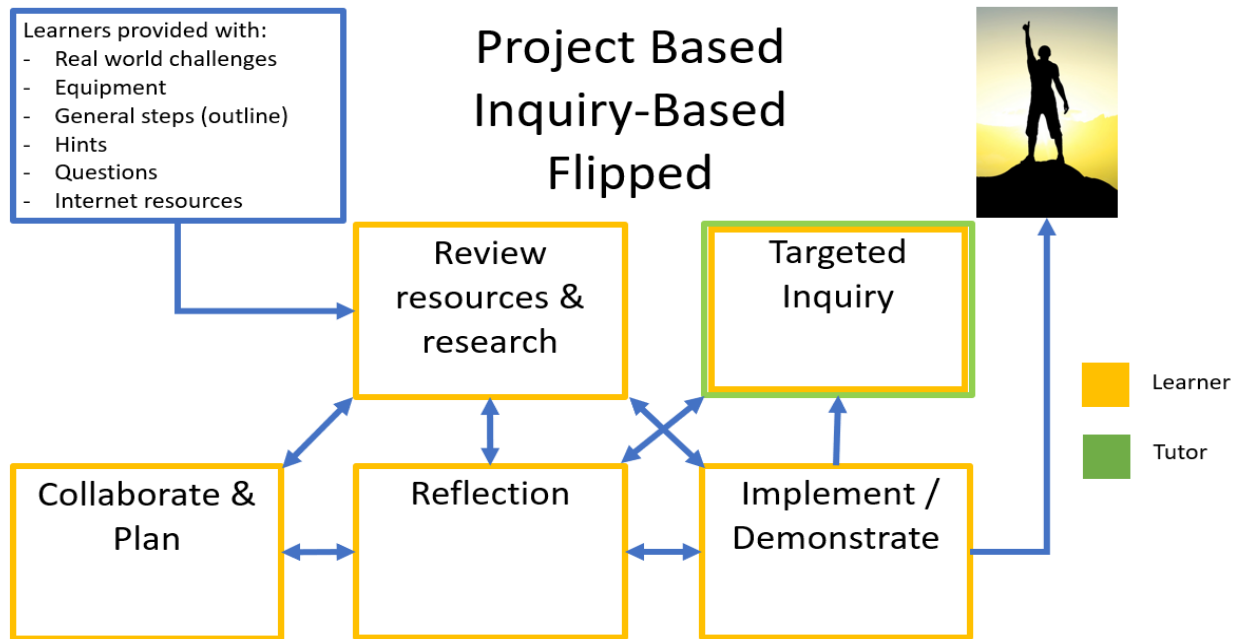
To make sense of these relationships, one has to know the preferred poles of the various constructs. The preferred poles are known as emergent and their opposites, contrast poles (Fransella, et al., 2004). When the preferred poles are known, one is able to interpret one's findings. For example, when the poles of constructs and their ratings are reversed so that all preferred poles are aligned, all correlations should be positive. Negative correlations would most likely signal what are known as implicative dilemmas (Greyling & Lingard, 2015) which generally represent an inconsistency in the person's network of constructs.

## SECOND AUTHOR'S MODEL FOR PROJECT-BASED FLIPPED CLASSROOM LEARNING

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Second author's model for a project-based flipped classroom is outlined in the diagram below. In the explanatory notes, a brief summary is provided of the teacher and learner roles, as well as the principles and practices associated with an inquiry-based approach (which is inherent to project-based and flipped classrooms):

Diagram 1: Individualised model of project-based flipped classroom learning



**Explanatory notes**

- **Resources** (equipment, a general step-by-step plan, and internet resources) are made available.
- The internet resources provided have many details and steps that the learner may use to solve the problem.
- **IT projects:** The educator presents a series of real-life IT networking projects to be completed.
- **Learner-centred:** Learners may take their own unique path through the model as learning styles may differ. E.g. some may spend more time in the collaboration phase and others will spend more time reviewing the online guides.
- **Predictable outline of projects:** Each project follows a predictable pattern: a general task, inquiry-based research questions, equipment, software, a very general (often intentionally vague) outline of the project, and recommended resources.
- **Principles and practices:**
  - **Principle 1 - Acknowledge learners' current and potential skill:** The teaching is pitched at a level where learners' current competence would be an adequate stepping stone to elaborate their skills and knowledge through inquiry-based learning.
  - **Principle 2 - Specify classroom participants' responsibilities in inquiry-based learning:** The tutor's role would be to structure project instruction guides, useful internet resources and learning spaces where learners take optimal responsibility for their learning. They also guide the student to solve problems that arise using inquiry techniques
  - **Principle 3 - Design and enact learning that develops learner autonomy:** The target would be to promote learner autonomy and their ability to think and reason in the IT networking field.

**FINDINGS: REFLECTING ON A PROJECT-BASED APPROACH**

**Focus of convenience:** The repertory grid is intended to highlight the patterns of meaning-making in the educator's perception and enactment of the principles and practices associated with project-based flipped classroom in an IT networking course (Fransella, et al., 2004).

**Elements:** The following elements were used in this grid (see Appendix A), and entered individually in the Table below:

- E1: My ideal approach to teaching and learning on my programme
- E2: My current approach to teaching and learning on my programme
- E3: A colleague whose approach to teaching and learning is diametrically opposed to mine
- E4: What I deem to be the best conditions for effective and efficient teaching and learning
- E5: What I think Wintec expects of me as a tutor
- E6: What my learners expect of me as their tutor
- E7: What I think the Ako: Teaching and Learning Directions document expects of me.
- E8: What I think Industry expects me to achieve with students on my programme
- E9: How I see project-based and inquiry-based learning
- E10: How I view my practices from ten years ago

On completing the grid, the SA realized that E1 and E4, as well as E5 and E7, coincided. Hence, these pairs of elements were conflated, yielding an 8 x 10 grid (and 80 ratings).

**Constructs:** The following ten constructs were elicited from the following combination of elements – E2, E7 and E9. These elements relate to the SA's current practices, Wintec expectations based on the *Ako Teaching and Learning Directions* and the tutor's perceptions of project-based and inquiry-based learning. The ten constructs were elicited and refined. The formulations were co-constructed to arrive at verbal labels which, in the SA's view, best captured his perception. The emergent poles are marked with an (E) in cursive:

Table 1: Sample page for ratings grid consisting of bipolar constructs and 7-point rating scale

Pole A	Constructs	Pole B
Element		
C1: Implicitly establishing and maintaining specific role definitions for classroom participants	1 2 3 4 5 6 7	Deliberately establishing and maintaining specific role definitions for classroom participants (E)
C2: Controlling learners' mastery through teacher mediation	1 2 3 4 5 6 7	Creating opportunities for learners to develop autonomy (E)
C3: <i>Teacher mediation as prompting and clue-giving</i> (E)	1 2 3 4 5 6 7	Teacher mediation as knowledge transfer
C4: Neglecting to complete the process specified at the start	1 2 3 4 5 6 7	Completing the process specified at the start (E)
C5: <i>Fully relevant online resources</i> (E)	1 2 3 4 5 6 7	Partially relevant online resources
C6: Detailed steps in the assessment instructions	1 2 3 4 5 6 7	Vague steps in the assessment instructions. (E)
C7: Incidentally tracking shifts, stasis and regress in learners developing autonomy	1 2 3 4 5 6 7	Deliberately tracking shifts, stasis and regress in learners developing autonomy (E)
C8: <i>Deliberately changing the ratio of teacher mediation to autonomous learner action</i> (E)	1 2 3 4 5 6 7	Incidentally changing the ratio of teacher mediation to autonomous learner action
C9: <i>Using questioning strategies to confirm and validate task completion</i> (E)	1 2 3 4 5 6 7	Neglecting to use questioning strategies to confirm and validate task completion
C10: <i>Employing reflective dialogues with learners</i> (E)	1 2 3 4 5 6 7	Employing teacher feedback sessions as reflection

**Findings as prompts for reflection.** The findings generated by the study allowed us to develop prompts for reflection:

- Principal components (factor) analytic results, specifically the rotated components matrix reporting the loadings on two identified factors, which explain 88.7% (Component 1=60.3% and Component 2=28.3%) of the variance in the ratings in the grid. In Table 2, we highlight the significance of these two components in our reflection.

- **Reflection tasks for SA:** The loadings in yellow in each column indicate the constructs that belong to each component. The question is then to consider how the emergent poles of the so-identified constructs share a commonality.

Table 2: Principal Components – Identifying two factors

Principal Components Analysis			Identifying the common factors
Rotated Component Matrix <sup>a</sup>			<p><b>Reflection task:</b> Identify the commonalities in the following combinations of constructs and describe the common factor in each case:</p> <p><b>Component (factor) 1 – constructs 2, 4, 5, 6, 9 and 10</b>                      What would be the common theme for the following poles of your constructs?                      C2: Creating opportunities for learners to develop autonomy                      C4: Completing the [educational] process specified at the start                      C5: Fully relevant online resources                      C6: Vague steps in the assessment instructions                      C9: Using questioning strategies to confirm and validate task completion                      C10: Employing reflective dialogues with learners</p> <p><b>Component (factor) 2 – constructs 1, 3, 7, and 8</b>                      What would be the common theme for the following poles of your constructs?                      C1: Deliberately establishing and maintaining specific role definitions for classroom participants                      C3: Teacher mediation as prompting and clue-giving                      C7: Deliberately tracking shifts, stasis and regress in learners developing autonomy                      C8: Deliberately changing the ratio of teacher mediation to autonomous learner action</p>
	Component		
	1	2	
C1	0.181	0.948	
C2	0.977	0.101	
C3	0.417	0.717	
C4	0.938	0.252	
C5	0.648	0.565	
C6	0.946	-0.038	
C7	-0.022	0.965	
C8	0.023	0.989	
C9	0.910	0.354	
C10	0.916	0.022	
Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization. a. Rotation converged in 3 iterations.			

**SA's response:** SA responded as follows to the reflection task in Table 2. The components, he argued, could be summarized as follows:

- Component 1: Transitioning from teacher-mediated learning to autonomous student learning.
- Component 2: The deliberateness of the teacher completing the processes outlined in the model and deciding which part of the spectrum is applicable in any given situation, for each individual construct.

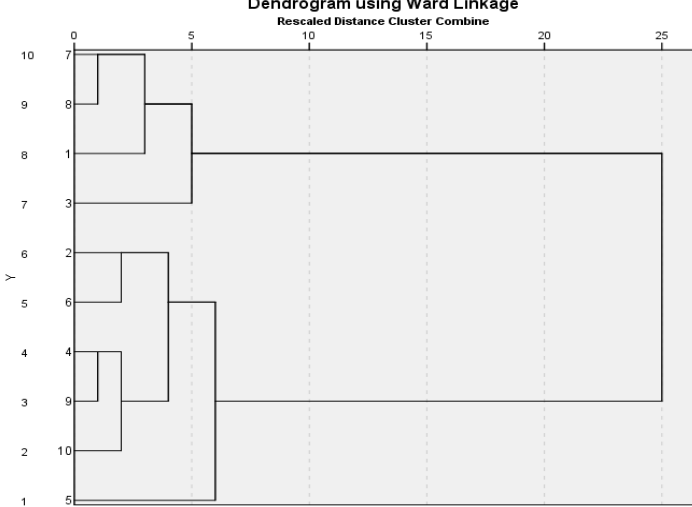
In our future reflections, we could further explore his formulations. Specifically, these commonalities could be "laddered up" to identify the values associated with them (using successive why questions) or "laddered down" to identify how this transitioning process could be implemented and achieved (Fransella, et al., 2004). FA's account of the two components was the following:

Component 1 seems to refer to the "dynamic interplay of mediated learning and autonomous learner activity" while component 2 highlights the "deliberateness of SA's mediation and autonomy-developing strategies" (an email exchange between the authors on 13 August 2018).

We would be able to explore the meaningfulness of our phrasing in words such as "transitioning" and "dynamic interplay" of teacher mediation and learner autonomy.

- Cluster analytic results, specifically the constructs that are closely related in the dendrogram are found in Table 3 below. We see that constructs 1, 3, 8 and 7 appear in the cluster at the top, and constructs 2, 4, 5, 6, 9 and 10 in the lower cluster. These findings are therefore consistent with the PCA results in Table 2.

Table 3: Cluster analysis – Dendrogram of construct linkages

Cluster Analysis: Dendrogram	Labels for emergent/preferred poles of constructs
<p style="text-align: center;">Dendrogram using Ward Linkage Rescaled Distance Cluster Combine</p> 	<p><b>Cluster 1:</b>                      C1: Deliberately establishing and maintaining specific role definitions for classroom participants                      C3: Teacher mediation as prompting and clue-giving                      C7: Deliberately tracking shifts, stasis and regress in learners developing autonomy                      C8: Deliberately changing the ratio of teacher mediation to autonomous learner action</p> <p><b>Cluster 2:</b>                      C2: Creating opportunities for learners to develop autonomy                      C4: Completing the [educational] process specified at the start                      C5: Fully relevant online resources                      C6: Vague steps in the assessment instructions                      C9: Using questioning strategies to confirm and validate task completion                      C10: Employing reflective dialogues with learners</p>
<p>Critical-reflection questions to cross-validate the PCA findings:</p> <ul style="list-style-type: none"> <li>• How do the construct linkages in the dendrogram support the PCA?</li> <li>• Was there some ambiguity involved in the verbal labels associated with constructs 3 and 5?</li> </ul> <p>Note: On the vertical axis, ten constructs are listed (inside column).</p>	

**SA's response:** To the first critical-reflection question, *How do the construct linkages in the dendrogram support the PCA?*, SA responded as follows:

"I agree with the two distinct categories/components that were found and with how most of the constructs were grouped. There was only one that I would have swapped (highlighted below). I would have thought they would be grouped as follows:

**Component (factor) 1**

- C2: Creating opportunities for learners to develop autonomy
- C4: Completing the [educational] process specified at the start
- C5: Fully relevant online resources
- C6: Vague steps in the assessment instructions
- C9: Using questioning strategies to confirm and validate task completion
- C10: Employing reflective dialogues with learners
- C3: Teacher mediation as prompting and clue-giving

**Component (factor) 2**

- C1: Deliberately establishing and maintaining specific role definitions for classroom participants
- C7: Deliberately tracking shifts, stasis and regress in learners developing autonomy
- C8: Deliberately changing the ratio of teacher mediation to autonomous learner action

Constructs 2 and 3 were placed in two different groups. I am surprised that they are not more closely related as they are both about developing student autonomy. There are more comments about the linkages in the sections below."



**FA's comment:**

SA's comment about the location of Construct 3 is interesting – from FA's perspective it fits well into component 2 because teacher mediation is deliberate, while prompting and clue-giving are specific strategies to change learner role definitions (C1), develop learner autonomy (C7) and manipulate the ratio of teacher mediation and learner autonomy. That said, SA's interpretation was that C2 and C3 were well aligned, noting that teacher mediation (C3) is an opportunity to develop autonomy (C2). However, if we consider the correlational value, we see that the correlation of 0.53 ( $p=0.091$ ) is not statistically significant. Thus, in SA's judgement, this association is more significant than suggested by the correlation.

**SA's response:**

To the second question, *Was there some ambiguity involved in the verbal labels associated with constructs 3 and 5?*, the following response was provided:

"I found very little ambiguity in the labels associated with constructs 3 and 5. I agree with the results as construct 5 is different to the other constructs in that it focusses on the online resources that support the model rather than the teacher-learner interaction. It is nonetheless an important aspect to the process. If the online resources are relevant (especially at the start) students tend to trust the process and eventually start to develop autonomy by finding their own online resources. I agree that C5 and C6 are related, as seen in the results, as they both relate to the design of the assessment instructions."

**FA's comment:**

FA's intention with the question was to explore the notion that fully relevant internet resources (C5) would run counter the drive for learner autonomy – partially relevant resources would prompt learners to pursue additional resources. This was indeed what students did – they searched for additional material. The contradiction, as FA saw it, was that providing a complete set of resources would negate the autonomy-seeking activity of searching for additional sources of information. SA's view was based on the ethical imperative to make fully relevant resources available so that all learners had access to resources which, if used, would be adequate for purposes of dealing with the projects.

- Correlations were used to explore levels of association between constructs. We focused on correlations that were above the 0.8 threshold ( $r>0.8$  and significant at the 1% or 0.001 level). These values indicate the level of association between the emergent poles of the various constructs.



**Table 4: Correlation Matrix**

		C1	C2	C3	C4	C5	C6	C7	C8	C9	C10
Correlation	C1	1.000	0.314	0.764	0.354	0.719	0.177	0.848	0.913	0.487	0.101
	C2	0.314	1.000	0.525	0.907	0.707	0.933	0.027	0.096	0.921	0.844
	C3	0.764	0.525	1.000	0.516	0.445	0.392	0.641	0.685	0.579	0.453
	C4	0.354	0.907	0.516	1.000	0.744	0.831	0.272	0.295	0.969	0.909
	C5	0.719	0.707	0.445	0.744	1.000	0.603	0.486	0.563	0.827	0.450
	C6	0.177	0.933	0.392	0.831	0.603	1.000	-0.084	-0.018	0.786	0.827
	C7	0.848	0.027	0.641	0.272	0.486	-0.084	1.000	0.990	0.328	0.086
	C8	0.913	0.096	0.685	0.295	0.563	-0.018	0.990	1.000	0.368	0.080
	C9	0.487	0.921	0.579	0.969	0.827	0.786	0.328	0.368	1.000	0.837
	C10	0.101	0.844	0.453	0.909	0.450	0.827	0.086	0.080	0.837	1.000
Sig. (1-tailed)	C1		0.224	0.014	0.195	0.022	0.337	0.004	0.001	0.111	0.406
	C2	0.224		0.091	0.001	0.025	0.000	0.474	0.411	0.001	0.004
	C3	0.014	0.091		0.095	0.135	0.168	0.043	0.031	0.066	0.130
	C4	0.195	0.001	0.095		0.017	0.005	0.257	0.239	0.000	0.001
	C5	0.022	0.025	0.135	0.017		0.057	0.111	0.073	0.006	0.131
	C6	0.337	0.000	0.168	0.005	0.057		0.421	0.483	0.010	0.006
	C7	0.004	0.474	0.043	0.257	0.111	0.421		0.000	0.214	0.419
	C8	0.001	0.411	0.031	0.239	0.073	0.483	0.000		0.185	0.425
	C9	0.111	0.001	0.066	0.000	0.006	0.010	0.214	0.185		0.005
	C10	0.406	0.004	0.130	0.001	0.131	0.006	0.419	0.425	0.005	

**Reflection task:** Very close linkages exist among the emergent poles of some of the constructs. From your perspective, explain the high levels of association between the following constructs (see Table 3 for Linkages and Table 4 for correlations and significance):

- C1 x C7 ( $r = 0.848, p < 0.004$ )
- C1 x C8 ( $r = 0.913, p < 0.001$ )
- C7 x C8 ( $r = 0.990, p < 0.000$ )
- C4 x C9 ( $r = 0.969, p < 0.000$ )
- C2 x C6 ( $r = 0.933, p < 0.000$ )

**SA's response:** SA's interpretations appear below:

"I agree with the following:

- C1, C7 and C8 are all closely related. The highest correlation is between C7 and C8. This makes a lot of sense, as deliberately tracking shifts in learner autonomy (C7) would directly lead to changing the ratio of teacher mediation (C8).
- Deliberately changing the ratio of teacher mediation (c8) implicitly strengthens specific role definitions between the teacher and student (C1). In saying that there are other factors that affect C1 such as the importance of meta talk as well as the other constructs that were found to be linked to C1 in the dendrogram.
- C1 and C7 are also related due to the above two points.
- If the assessment instructions are overly detailed (C6) then this tends to reduce the opportunities for students to think for themselves and solve problems (C2) and they start to complain if there is one small step missing. In saying that if the instructions are too vague then students could get stuck.

- I would **not** have thought C4 and C9 would have such a high correlation. C9 is more to do with informally assessing of the ability of the student at the end of the project.”

**FA’s response:**

SA was able to interpret the correlations. His interpretations show his insight into the dynamic relationships among the preferred poles of his constructs. He was able to make sense of the interactions among constructs, providing evidence of going beyond discrete constructs to define a deeper level of complexity and the relatedness of constructs.

The last comment (see last bullet directly above) may be viewed as interesting. Why would persistence in applying the model of delivery be highly associated with using questioning strategies to validate learner decisions? It seemed to FA that this level of association represented SA’s perception of inquiry-based learning as consistently and overwhelmingly associated with learner-centred questioning. Thus, a questioning commitment, in his view, would be a typical characteristic of project-based flipped classroom (driven by inquiry-based learning).

We concluded that

- **collaborative interpretation supports reflection** – we illustrated that SA, as the primary knower, had the right to validate, reject or modify interpretations irrespective of their origin. For example, SA was surprised by the high level of association between “Completing the educational process specified at the start of the programme” (C4) and “using questioning strategies to confirm and validate task completion” (C9). This made it explicit to him that the pedagogical strategy he had been pursuing was highly associated with a commitment to asking questions, yet, as primary knower it was for him to accept or reject the interpretation.
- **level of association between constructs and probability values may be significant, but primary knower knows best:** As stated above, the high level of association and the highly significant probability value for C4 and C9 ( $r=.929$ ;  $p<0.000$ ) implied that the ratings **could be** connected. Although a significant correlation was found, it was for SA to interpret the finding. FA could only provide possible interpretative options as the secondary knower. For example, FA could point out that the pedagogical strategy he had been pursuing was highly associated with a commitment to asking questions. However, SA, as the primary knower, had to be cast in the role of validating, modifying or rejecting the implication.
- **reflection may identify points for collaborative re-interpretation:** The examples discussed above (C2 and C3, C4 and C9) highlight two points for on an agenda for collaborative re-interpretation. There were many more.<sup>3</sup>

## TRIANGULATION: CLASSROOM OBSERVATIONS AS SOURCES OF EVIDENCE

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**Triangulated practice:** The repertory grid provides a numerical narrative of the associated pedagogical meanings in the tutor’s construct system. These meanings have to be viewed against two detailed classroom observations which reinforce the emergent and preferred poles of the ten constructs selected for this study. To develop a more holistic view of what happened in second author’s classroom, FA activated lenses from classroom discourse analysis to explore the how of his approach. The description provides an account of the discourse practices observed to implement a project-based flipped classroom and as stated earlier may be used to triangulate our account (Viney & Nagy, 2012).

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<sup>3</sup> . We could also have explored how the elements were related to see how, for example, E5 (What I think Wintec expects of me) was associated with E2 (My current approach to teaching and learning on my programme). Such an analysis would uncover consistencies and inconsistencies in how these elements are perceived.

**Description from classroom observation:** We cite two sections from the first classroom observation. The educator initiated the session, embarking upon structuring talk (Greyling, 1995). Here we use the term *structuring* to refer to the tutor's interactive discourse activities, as he initiated the teaching and learning cycle at the start of the module to establish a specific classroom routine, define participants' role and familiarise students with the model of learning.

The tutor used **meta-talk** to outline the content and outcomes of the module (answering the what-is-to-be-learnt question), how teaching and learning would be accomplished (procedures and processes), and the model of mediated learning.

- **Exploring learners' prior knowledge:** In the opening session, the educator knew that students were not entirely new to the practices and activities in learning at Wintec. The educator worked on the assumption that learners were able to access the Moodle course on the intranet. Learners responded non-verbally performing the log-on task. The assumption was that they were already familiar with the logging on process. SA consistently linked queries to other topics, exploring participating students' knowledge base.
- **Goal-defining educator talk:** The educator outlined the course, the IT work-ready skills to be pursued, and the duration of the learning. The emphasis in his initiation was on the labs, equipment and the process. The educator talked about the course, linking the theory to practical projects and assessments.
- **A questioning commitment embedded in a research orientation:** The educator highlighted the importance of questioning knowledge to unpack the reasoning associated with a domain of competence, as well as the value of a research orientation to manage information intended to solve project-based tasks in a vocational field.
- **Role-defining language acts** relate to the participants' roles, specifically the educator defining the rules of appropriate interaction for all participants. The educator described an educator-mediated project-based approach which was based on a multi-directional cycle of teacher-learner and learner-learner exchanges (see Diagram 1).
- **Process-defining language acts** refer to how teaching and learning are to be accomplished. The educator stipulated the rituals and routines associated with accomplishing the goals of the course. These included how the tasks and projects had to be completed, the information-gathering and skills-mastery components, as well as his own role as a guide on the side. The educator also discussed the timeline and the schedule to be followed, as well as specifics about the projects, tasks and activities included in the course.
- **Attention-seeking language acts** refer to the language used by educators to secure learners' attention and switching from pair or group mode to full class mode. Mode switching occurred when the educator felt it imperative to share information with the wider group, or when he mode-switched to manage a boundary between phases, activities or processes in the session.
- **Interactional patterns** typically associated with these boundaries in classroom discourse were the following:
  - **Verbal-nonverbal exchanges** related to educator instructions followed by non-verbal learner actions which confirmed their understanding and knowledge of the appropriate non-verbal response to a verbal initiation. This happened consistently in this session. For example, the tutorial exercise was the outcome of an educator initiation, followed by the learners accessing the task (non-verbal), followed by pair and group talk (verbal) as they attempted to solve a problem-based task (non-verbal action – the practical management of Docker files).
  - **Pair and group interactions** were used to mobilize learner-learner exchanges as a means to manage information and tasks. Having found information on Google, learners interacted in different ways to address the project tutorial as a collaboratively accomplished outcome. Some of the exchanges involved the following pair and group exchanges:

- **Coordinated statement turns** involved the current learner making a statement, and the next speaker contributing at a point of transition.
- **Learner-initiated exchanges within pairs and groups** involved learners initiating by asking questions, followed by fellow learners providing clarifying statements.
- **Extended sequences of interaction** refer to an educator strategy aimed at circumventing barriers in the interaction (Greyling, 1995). For example, the educator asks a question and no one responds. Using a series of questions, prompts and clues, the educator guides learners to an understanding of the topic which then results in the learner being able to answer the initial question. The educator consistently used this exchange pattern to process and review learner responses, unpacking the meanings in their responses through multiple question-answer-evaluation sequences, sometimes using a statement turn before asking the question. The educator consistently worked the group to check on learner understandings and elaborating their conceptual knowledge.
- **Continuity in the learning conversations and the learning:** The educator used hints, clues and prompts to ensure that learning and learning conversations would flow.

## TRIANGULATION: LEARNER PERSPECTIVES

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**Student perceptions as triangulation:** FA had informal discussions with the class to elicit their reflections on teaching and learning on this programme, and to incorporate a learner perspective. Their observations are summarized below.

- **Switching roles and reshaping learner identities:** Learners struggled to switch roles, having to find, manage and interpret new information to solve a project-based task; they nonetheless understood the rationale and viewed themselves as having developed trouble-shooting skills in IT networking.
- **Learner tensions and inquiry-based learning:** Learners were sometimes frustrated with the vague steps for the projects, intentionally designed into the projects to prompt learners to engage in inquiry-based learning. Several of the learners confirmed that they understood the reasoning behind the approach.
- **Learners understood the teaching style:** SA would give limited clues and hints, refer to a direction they could take, and would then walk away. Learners understood that the SA's teaching strategies were aimed at developing learner autonomy, specifically how they accessed, managed and used sources of knowledge and skill.
- **Developing information literacy:** Learners were aware that the approach placed the module within the framework of information literacy and knowledge management.
- **Developing a learner-centred and inquiry-based approach:** Learners were aware of the fact that SA's approach was intended to challenge them to reflect on their role definitions as learners and potential IT practitioners. They agreed that a learner-centred inquiry-based approach was more helpful than a traditional information-transfer approach.
- **Improving work-ready skills:** Learners were unanimous that they had gained work-ready skills and that they were more employable than before. One of the students was critical, expecting more in-depth training in fewer networking technologies. This led to an interesting discussion between the authors about breadth and depth of skill, information-management and trouble-shooting skills, as well as learner autonomy.

## DISCUSSION

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A number of key points can be made about this small-scale project. The first is that the three sources of data yielded evidence triangulating the principles and practices of SA's model of project-based flipped classroom learning. We quote the three principles and practices from Diagram 1:

**Principle 1: Acknowledge learners' current and potential skill:** The teaching had to be pitched at a level where learners' current competence would be an adequate stepping stone for elaborating their knowledge and skill through inquiry-based learning.

**Principle 2: Specify classroom participants' responsibilities in inquiry-based learning:** The tutor's role would be to structure inquiry-based learning projects and learning spaces where learners took optimal responsibility for their learning.

**Principle 3: Design and enact learning that develops learner autonomy:** The target would be to promote learner autonomy and their ability to think and reason in the IT networking field.

SA's teaching role allowed him to design the model he wanted to implement, select resources and design tasks which he believed would develop learners' thinking and reasoning to solve problems in the IT networking field (Principle 2). He established what the task demands would be in the IT field and the difficulty level of task (following New Zealand Qualification Authority level descriptors) before designing projects that would challenge learners to extend and elaborate their knowledge and skill in the IT networking field (Principle 1). Learners confirmed that they learnt much from the eight small-scale IT projects they had been assigned. Consistently, they stated that they had developed trouble-shooting skills for IT networking (Principle 2). They also confirmed that by the end of the course they had gained autonomy as learners beyond what they had at the start of the programme (Principle 3).

SA's intention from the start was to establish role definitions which cast him and the learners in roles that promoted learner autonomy (Principle 3). In our view, SA's interactional strategies showed the discursive means employed to accomplish his model as an interactive event. SA intentionally designed a speech exchange system and crafted roles associated with the tutor as mediator and the learners as active participants in small-scale IT problem-solving projects (Principle 2). These interactional strategies included meta-talk associated with goal-defining talk, making explicit the importance of a questioning commitment and research orientation, role-defining language acts, process-defining language acts, and attention-seeking language acts. Other significant discursive patterns included interactions in small groups and pairs, as well as the endemic presence of extended question-answer-evaluation sequences. These interactional strategies allowed SA to manage the learning process, as well as manage opportunities in tutor-learner interactions to develop their thinking and reasoning (Principle 1).

## CONCLUSIONS

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**Multiple sources of data:** We concluded that triangulation was key to our reflective exchanges. Triangulation allowed us to find evidence from various sources to support and contextualise our conclusions. The repertory grid allowed us to elicit SA's constructs, making explicit his pedagogical thinking. Classroom observations represented evidence of pedagogical action, showing how constructs were aligned with the "doing". The third source of evidence, the learners, was equally important – they articulated the challenges they experienced and validated SA's approach as meaningful in developing their information-management and trouble-shooting skills in a range of IT networking technologies.

**From tacit to explicit knowledge:** We reasoned that our account of what occurred in this small-scale project was one among many possible accounts of the dynamics in his classroom. Re-interpretations of the evidence were possible, and multiple accounts would uncover more layers hidden in the evidence. No interpretation of evidence can ever be final. By

activating multiple lenses in assigning meaning to our experiences, we believed we had adopted a flexible and questioning mindset receptive to new interpretations.

**The repertory grid as a reflective tool:** The act of eliciting constructs is the first order of reflective practice. Finding the most appropriate formulations for constructs is the second order of reflection: we believe that language allows us to craft the best possible, yet neither perfect nor final, sense-making lenses. The third order of reflection occurs when the grid is administered and ratings generated. The next order of reflection occurs when findings are interpreted.

**Conclusions:** We concluded that the repertory grid is a useful tool in reflective practice. Specifically, our grid use

- allowed both authors to reflect on SA's implementation of a project-based flipped classroom, capturing an account of SA's thinking and how these were related to deliberate acts of doing in his teaching practices (classroom observations).
- gained in meaningfulness when we triangulated these against student perceptions which showed that they struggled with the learner-centred role switch and the intentionally vague project information (step-by-step outlines of projects), yet understood and embraced the approach as empowering.
- exposed the tip of the iceberg: much more can be extracted from the grid, especially if its elements were analysed (see footnote 3).
- showed that collaborative interpretation and re-interpretation supported reflection – we illustrated that SA, as the primary knower, validated interpretations irrespective of their origin. For example, SA was surprised by the high level of association between “Completing the educational process specified at the start of the programme” (C4) and “using questioning strategies to confirm and validate task completion” (C9).
- was based on the premise that FA could, at best, provide hypothetical and tentative interpretations of the findings, and that SA could entertain, interpret and accept or reject these meanings.

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**APPENDIX A: SECOND AUTHOR'S REPERTORY GRID FOR A PROJECT-BASED FLIPPED CLASSROOM**
**REPERTORY GRID FOR REFLECTIVE PRACTICE IN TERTIARY EDUCATION PROGRAMMES**


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**Focus of convenience**

Reflecting on one's pedagogy in a tertiary educational context

**Procedure:**

In this repertory grid, you are requested to consider each element from the point of view of the ten constructs listed below it.

If you believe that the element (an aspect of your practice), should be judged on the left of the scale, mark the appropriate number:

1 = very strongly agree

2 = strongly agree

3 = agree

If the pole on the right of the scale is preferred, mark the appropriate number on that side of the scale:

7 = very strongly agree

6 = strongly agree

5 = agree

Be certain of a 4 rating that both poles are relevant..

**Example:** Read the element; then rate it in terms of the two poles. Let us say that my approach is consistently and frequently to use pair work and small groups in my lessons, I would opt for Pole A. Let's say that I very strongly believe in this kind of teaching, I would rate the element as a 1 (very strongly agree that Pole A is the most appropriate).

Pole A	Constructs	Pole B
Element: Interaction with students to achieve the project-based objectives of the lesson		
Using learner-learner interactive tasks to achieve the lesson outcomes	1 2 3 4 5 6 7	Using educator-learner question-answer-evaluation sequences to achieve lesson objectives

**Reasoning A:** If the project is tightly controlled, with step-by-step checks, the teacher would mark, say, 6, or either 5 or 7, depending on the intensity of the response.

**Reasoning B:** If the project has been structured as open-ended, with learners having freedom to seek unique solutions within small groups, the teacher would mark, say, 1, or either 2 or 3, depending on the intensity of the response.

Pole A	Constructs	Pole B
Element 1: My ideal approach to teaching and learning on my programme		
Implicitly establishing and maintaining specific role definitions for classroom participants	1 2 3 4 5 6 7	Deliberately establishing and maintaining specific role definitions for classroom participants
Controlling learners' mastery through teacher mediation	1 2 3 4 5 6 7	Creating opportunities for learners to develop autonomy
Teacher mediation as prompting and clue-giving	1 2 3 4 5 6 7	Teacher mediation as knowledge transfer
Neglecting to complete the process specified at the start	1 2 3 4 5 6 7	Completing the process specified at the start
Fully relevant online resources	1 2 3 4 5 6 7	Partially relevant online resources
Detailed steps in the assessment instructions	1 2 3 4 5 6 7	Vague steps in the assessment instructions.
Incidentally tracking shifts, stasis and regress in learners developing autonomy	1 2 3 4 5 6 7	Deliberately tracking shifts, stasis and regress in learners developing autonomy
Deliberately changing the ratio of teacher mediation to autonomous learner action	1 2 3 4 5 6 7	Incidentally changing the ratio of teacher mediation to autonomous learner action
Using questioning strategies to confirm and validate task completion	1 2 3 4 5 6 7	Neglecting to use questioning strategies to confirm and validate task completion
Employing reflective dialogues with learners	1 2 3 4 5 6 7	Employing teacher feedback sessions as reflection

Pole A	Constructs	Pole B
Element 2: My current approach to teaching and learning on my programme		
Implicitly establishing and maintaining specific role definitions for classroom participants	1 2 3 4 5 6 7	Deliberately establishing and maintaining specific role definitions for classroom participants
Controlling learners' mastery through teacher mediation	1 2 3 4 5 6 7	Creating opportunities for learners to develop autonomy
Teacher mediation as prompting and clue-giving	1 2 3 4 5 6 7	Teacher mediation as knowledge transfer
Neglecting to complete the process specified at the start	1 2 3 4 5 6 7	Completing the process specified at the start
Fully relevant online resources	1 2 3 4 5 6 7	Partially relevant online resources
Detailed steps in the assessment instructions	1 2 3 4 5 6 7	Vague steps in the assessment instructions.
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Deliberately changing the ratio of teacher mediation to autonomous learner action	1 2 3 4 5 6 7	Incidentally changing the ratio of teacher mediation to autonomous learner action
Using questioning strategies to confirm and validate task completion	1 2 3 4 5 6 7	Neglecting to use questioning strategies to confirm and validate task completion
Employing reflective dialogues with learners	1 2 3 4 5 6 7	Employing teacher feedback sessions as reflection

Pole A	Constructs	Pole B
Element 3: A colleague whose approach to teaching and learning is diametrically opposed to mine		
Implicitly establishing and maintaining specific role definitions for classroom participants	1 2 3 4 5 6 7	Deliberately establishing and maintaining specific role definitions for classroom participants
Controlling learners' mastery through teacher mediation	1 2 3 4 5 6 7	Creating opportunities for learners to develop autonomy
Teacher mediation as prompting and clue-giving	1 2 3 4 5 6 7	Teacher mediation as knowledge transfer
Neglecting to complete the process specified at the start	1 2 3 4 5 6 7	Completing the process specified at the start
Fully relevant online resources	1 2 3 4 5 6 7	Partially relevant online resources
Detailed steps in the assessment instructions	1 2 3 4 5 6 7	Vague steps in the assessment instructions.
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Deliberately changing the ratio of teacher mediation to autonomous learner action	1 2 3 4 5 6 7	Incidentally changing the ratio of teacher mediation to autonomous learner action
Using questioning strategies to confirm and validate task completion	1 2 3 4 5 6 7	Neglecting to use questioning strategies to confirm and validate task completion
Employing reflective dialogues with learners	1 2 3 4 5 6 7	Employing teacher feedback sessions as reflection

Pole A	Constructs	Pole B
Element 4: What I deem to be the best conditions for effective and efficient teaching and learning		
Implicitly establishing and maintaining specific role definitions for classroom participants	1 2 3 4 5 6 7	Deliberately establishing and maintaining specific role definitions for classroom participants
Controlling learners' mastery through teacher mediation	1 2 3 4 5 6 7	Creating opportunities for learners to develop autonomy
Teacher mediation as prompting and clue-giving	1 2 3 4 5 6 7	Teacher mediation as knowledge transfer
Neglecting to complete the process specified at the start	1 2 3 4 5 6 7	Completing the process specified at the start
Fully relevant online resources	1 2 3 4 5 6 7	Partially relevant online resources
Detailed steps in the assessment instructions	1 2 3 4 5 6 7	Vague steps in the assessment instructions.
Incidentally tracking shifts, stasis and regress in learners developing autonomy	1 2 3 4 5 6 7	Deliberately tracking shifts, stasis and regress in learners developing autonomy
Deliberately changing the ratio of teacher mediation to autonomous learner action	1 2 3 4 5 6 7	Incidentally changing the ratio of teacher mediation to autonomous learner action
Using questioning strategies to confirm and validate task completion	1 2 3 4 5 6 7	Neglecting to use questioning strategies to confirm and validate task completion
Employing reflective dialogues with learners	1 2 3 4 5 6 7	Employing teacher feedback sessions as reflection

Pole A	Constructs	Pole B
Element 5: What I think Wintec expects of me as a tutor		
Implicitly establishing and maintaining specific role definitions for classroom participants	1 2 3 4 5 6 7	Deliberately establishing and maintaining specific role definitions for classroom participants
Controlling learners' mastery through teacher mediation	1 2 3 4 5 6 7	Creating opportunities for learners to develop autonomy
Teacher mediation as prompting and clue-giving	1 2 3 4 5 6 7	Teacher mediation as knowledge transfer
Neglecting to complete the process specified at the start	1 2 3 4 5 6 7	Completing the process specified at the start
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Using questioning strategies to confirm and validate task completion	1 2 3 4 5 6 7	Neglecting to use questioning strategies to confirm and validate task completion
Employing reflective dialogues with learners	1 2 3 4 5 6 7	Employing teacher feedback sessions as reflection

Pole A	Constructs	Pole B
Element 6: What my learners expect of me as their tutor		
Implicitly establishing and maintaining specific role definitions for classroom participants	1 2 3 4 5 6 7	Deliberately establishing and maintaining specific role definitions for classroom participants
Controlling learners' mastery through teacher mediation	1 2 3 4 5 6 7	Creating opportunities for learners to develop autonomy
Teacher mediation as prompting and clue-giving	1 2 3 4 5 6 7	Teacher mediation as knowledge transfer
Neglecting to complete the process specified at the start	1 2 3 4 5 6 7	Completing the process specified at the start
Fully relevant online resources	1 2 3 4 5 6 7	Partially relevant online resources
Detailed steps in the assessment instructions	1 2 3 4 5 6 7	Vague steps in the assessment instructions.
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Deliberately changing the ratio of teacher mediation to autonomous learner action	1 2 3 4 5 6 7	Incidentally changing the ratio of teacher mediation to autonomous learner action
Using questioning strategies to confirm and validate task completion	1 2 3 4 5 6 7	Neglecting to use questioning strategies to confirm and validate task completion
Employing reflective dialogues with learners	1 2 3 4 5 6 7	Employing teacher feedback sessions as reflection

Pole A	Constructs	Pole B
Element 7: What I think the Ako: <i>Teaching and Learning Directions</i> expects of me as a tutor		
Implicitly establishing and maintaining specific role definitions for classroom participants	1 2 3 4 5 6 7	Deliberately establishing and maintaining specific role definitions for classroom participants
Controlling learners' mastery through teacher mediation	1 2 3 4 5 6 7	Creating opportunities for learners to develop autonomy
Teacher mediation as prompting and clue-giving	1 2 3 4 5 6 7	Teacher mediation as knowledge transfer
Neglecting to complete the process specified at the start	1 2 3 4 5 6 7	Completing the process specified at the start
Fully relevant online resources	1 2 3 4 5 6 7	Partially relevant online resources
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Deliberately changing the ratio of teacher mediation to autonomous learner action	1 2 3 4 5 6 7	Incidentally changing the ratio of teacher mediation to autonomous learner action
Using questioning strategies to confirm and validate task completion	1 2 3 4 5 6 7	Neglecting to use questioning strategies to confirm and validate task completion
Employing reflective dialogues with learners	1 2 3 4 5 6 7	Employing teacher feedback sessions as reflection

Pole A	Constructs	Pole B
Element 8: What I think Industry expects me to achieve with students on my programme		
Implicitly establishing and maintaining specific role definitions for classroom participants	1 2 3 4 5 6 7	Deliberately establishing and maintaining specific role definitions for classroom participants
Controlling learners' mastery through teacher mediation	1 2 3 4 5 6 7	Creating opportunities for learners to develop autonomy
Teacher mediation as prompting and clue-giving	1 2 3 4 5 6 7	Teacher mediation as knowledge transfer
Neglecting to complete the process specified at the start	1 2 3 4 5 6 7	Completing the process specified at the start
Fully relevant online resources	1 2 3 4 5 6 7	Partially relevant online resources
Detailed steps in the assessment instructions	1 2 3 4 5 6 7	Vague steps in the assessment instructions.
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Deliberately changing the ratio of teacher mediation to autonomous learner action	1 2 3 4 5 6 7	Incidentally changing the ratio of teacher mediation to autonomous learner action
Using questioning strategies to confirm and validate task completion	1 2 3 4 5 6 7	Neglecting to use questioning strategies to confirm and validate task completion
Employing reflective dialogues with learners	1 2 3 4 5 6 7	Employing teacher feedback sessions as reflection

Pole A	Constructs	Pole B
Element 9: How I see project-based and inquiry-based learning		
Implicitly establishing and maintaining specific role definitions for classroom participants	1 2 3 4 5 6 7	Deliberately establishing and maintaining specific role definitions for classroom participants
Controlling learners' mastery through teacher mediation	1 2 3 4 5 6 7	Creating opportunities for learners to develop autonomy
Teacher mediation as prompting and clue-giving	1 2 3 4 5 6 7	Teacher mediation as knowledge transfer
Neglecting to complete the process specified at the start	1 2 3 4 5 6 7	Completing the process specified at the start
Fully relevant online resources	1 2 3 4 5 6 7	Partially relevant online resources
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Deliberately changing the ratio of teacher mediation to autonomous learner action	1 2 3 4 5 6 7	Incidentally changing the ratio of teacher mediation to autonomous learner action
Using questioning strategies to confirm and validate task completion	1 2 3 4 5 6 7	Neglecting to use questioning strategies to confirm and validate task completion
Employing reflective dialogues with learners	1 2 3 4 5 6 7	Employing teacher feedback sessions as reflection

Pole A	Constructs	Pole B
Element 10: How I view my practices from ten years ago		
Implicitly establishing and maintaining specific role definitions for classroom participants	1 2 3 4 5 6 7	Deliberately establishing and maintaining specific role definitions for classroom participants
Controlling learners' mastery through teacher mediation	1 2 3 4 5 6 7	Creating opportunities for learners to develop autonomy
Teacher mediation as prompting and clue-giving	1 2 3 4 5 6 7	Teacher mediation as knowledge transfer
Neglecting to complete the process specified at the start	1 2 3 4 5 6 7	Completing the process specified at the start
Fully relevant online resources	1 2 3 4 5 6 7	Partially relevant online resources
Detailed steps in the assessment instructions	1 2 3 4 5 6 7	Vague steps in the assessment instructions.
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Using questioning strategies to confirm and validate task completion	1 2 3 4 5 6 7	Neglecting to use questioning strategies to confirm and validate task completion
Employing reflective dialogues with learners	1 2 3 4 5 6 7	Employing teacher feedback sessions as reflection