Designing an Adaptive Expertise Video Survey Instrument

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Project team

Our team represents a collaboration between researchers at Monash University, Deakin University and University of Melbourne.

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“Imagine two sushi chefs: one who makes every piece perfectly but routinely makes the same few types over and over (classic or routine expertise), and one produces new menus frequently (adaptive expertise)”

- Hatano & Inagaki (1986)

Photo by Fadya Azhary on Unsplash

Screenshot of video by Make Sushi on Youtube

Adaptive Expertise Project Overview

Project aims: to improve theoretical and practical understanding of the nature and development of primary teachers' adaptive expertise in interdisciplinary mathematics and science.

Key research questions:

1. How can primary teachers' adaptive expertise in interdisciplinary mathematics and science be characterised in terms of components and levels?
2. To what extent, and how, does primary teachers' adaptive expertise change and develop during a trajectory across three school years aimed at interdisciplinary mathematics and science in a co-plan, co-teach and co-reflect approach?

Adaptive Expertise components (Yoon et al., 2019)

Component	Manifestation
Flexibility: the ability to opportunistically plan, change enactments faster than non-experts, and flexibly and critically apply their knowledge to new situations while constantly learning.	One's ability to integrate aspects of teacher knowledge in relation to the teaching act with the goal of improving outcomes while responding to their specific contexts.
Deep-level understanding: addresses the need to not only have acquired content and pedagogical knowledge, but to have a deep understanding of it in order to use such knowledge effectively.	One's ability to recognise meaningful patterns quickly, allowing one to attend to deeper-level problem solving and in turn perform at a higher level.
Deliberate practice: addresses the need for teachers to receive feedback about and reflect upon their teaching either directly from their observations, from student outcomes, or from outside perspectives, with the intent to shift their practice based on feedback and reflection.	One's ability to engage in reflection, conscious deliberation, and regulation processes.

Purpose of video survey instrument

- Identify variation in teachers' adaptive expertise.
- Compare their adaptive expertise over the three-year period, that is at the beginning and end of their engagement in the project.
- Responses will be analysed to identify evidence of the three characteristics of adaptive expertise – flexibility, deep-level of understanding and deliberate practice.

Design process for AE-VS instrument

Step 1	Independently viewing the two lesson videos to identify students' mathematical and scientific thinking that challenges teachers' ability to respond to students.
Step 2	Using a spreadsheet to record our critical moments, connection to theoretical framework and possible open items.
Step 3	Team meeting to compare selected challenging moments and discuss and relate these moments to theoretical framing of AE.
Step 4	Compiling possible video extracts to a common list for final discussion.
Step 5	Team meeting to discuss question structure: MC vs Open-ended. Drafting of multiple-choice items with audio explanation (Phonic) for the video extracts.
Step 6	Team meeting to make final selection of video items and the wording of MC options for each item.

Review of lesson videos

Step 1 Independently viewing the two lesson videos to identify students' mathematical and scientific thinking that challenges teachers' ability to respond to students.

Step 2 Using a spreadsheet to record our critical moments, connection to theoretical framework and possible open items.

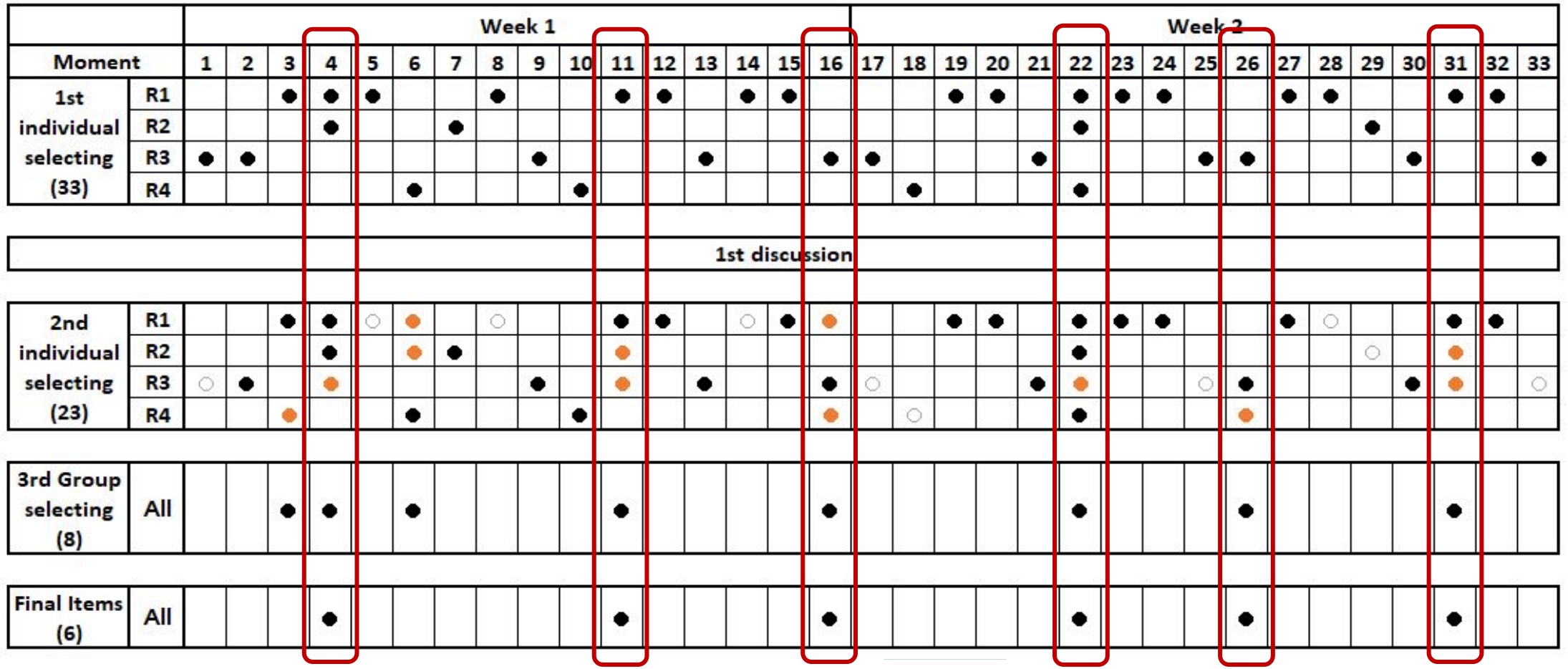
Video workshop survey

Lesson	Video file name	Time	Screen shot	Description	AE components	Possible questions
Week1	Day1_TeacherCam_FullAudio.mp4	24:06-25:08		Natalie asked "Will we count every single beat for a whole minute?". One student: Yes. Natalie: "We are going to sit there for a whole minute?" Student: Yeah... Natalie: Hm... Student: No,.. Yes... we are going to measure for 10 seconds and then multiply that by 6..... Natalie: Why 6?"	Deeper-level of understanding	How would you make connections that build deeper-level of knowledge of students based on this episode? What questions would you ask?

Results of individual/group review of lesson videos

Step 3 Team meeting to compare selected challenging moments and discuss and relate these moments to theoretical framing of AE.

Step 4 Compiling possible video extracts to a common list for final discussion.



Results of individual/group review of lesson videos

Step 5 Team meeting to discuss question structure: MC vs Open-ended.
Drafting of multiple-choice items with audio explanation (Phonic) for the video extracts.

Step 6 Team meeting to make final selection of video items and the wording of MC options for each item.

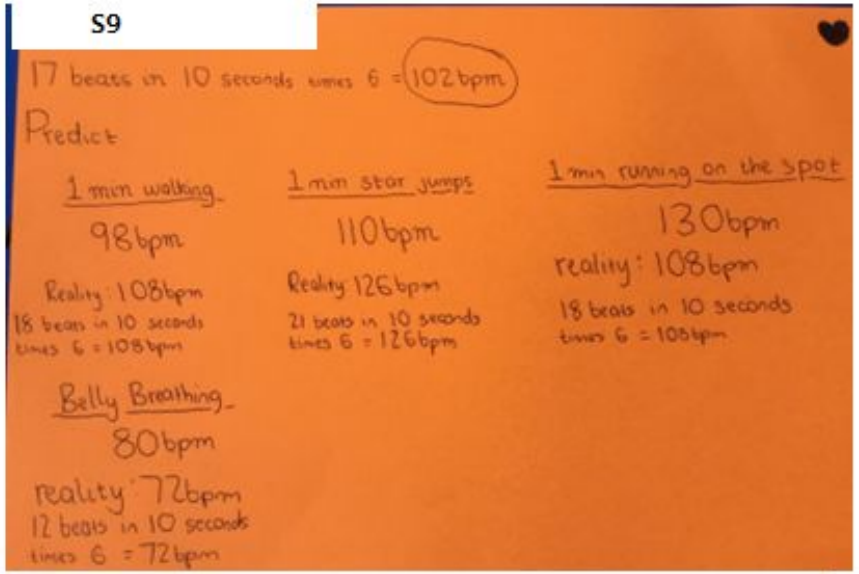
Item	AE(Field)	Descriptions	video & worksheet	Multi-choice answers
video 1	DLU(Maths)	Before class, the teacher planned an activity to count the heart beat for 15 seconds and multiply by 4 to calculate the heart beats per minute (bpm). In this video clip, the teacher is recording a student's alternative method of finding beats per minute (bpm) without having to count for a full minute. Please watch the video.		If you were the teacher, what would you do next? Choose one response from the list below. A. Ask another student to repeat this procedure using their own words. B. I, the teacher, would restate the procedure. C. Ask a student to explain why this procedure would work. D. Ask for another way to calculate beats per minute. E. Other actions you may take (please describe below).
video 2	DLU(M & S)	After students measured their resting heart rate, they had to predict and measure the change in their heart rate as they undertook various activities such as walking, star jumping, and running. In this video clip, the teacher is responding to a student who has just calculated their bpm after walking for a minute, before doing star jumps for a minute. Please watch the video.		What response or question would you have used when interacting with this student? Choose one response from the list below. A. "What did you find out?" B. "What do you think about your prediction for heart rate for star jumps?" C. "Do you think your heart rate for star jumps will be higher or lower than for walking? Why?" D. "I think you should change your prediction for star jumps, don't you?" E. Other questions you may ask (please describe below).
video 3	Flexibility	The teacher recorded the resting heart rate measured by the students in an Excel spreadsheet and shared it on the screen (see below). The minimum for the heart rate in the class was 60 bpm and the maximum was 120 bpm. The teacher discussed how to calculate the class average. In this video clip, the teacher is responding to a student who suggested that the average bpm for the		If this is a student in your class saying that the average is 166.1 bpm, how would you respond to the student? Choose one response from the list below. A. Tell students that 166.1 cannot be the average. B. Ask the student to explain how they worked out the average to be 166.1. C. Get the class to look through the data to reason why the average cannot be 166.1. D. Revisit the concept of average with the class. E. Other actions you may take (please describe below).
video 4	Flexibility	Recalling what they had learned in the previous lesson, the teacher discussed with the students the best way to measure heart rate that they used last week. In this video clip, a student asks the teacher whether the pulse rate would be slower near the neck compared to the wrist. Please watch the video.		If this is a student in your class, how would you respond? Choose one response from the list below. A. Explain to students that the pulse rate would be the same in the neck and the wrist. B. Ask students "How can you find this out?" C. Ask students "What do we know about blood circulation that can help us to find this out?" D. Guide the class to collect data to respond to this question. E. Other actions you may take (please describe below)
video 5	DLU(Science)	After working out the class average for bpm, the teacher explores the notion of range with students. In this video clip, the teacher discusses with the class why heart rate is a range rather than a specific number. Please watch the video.		If you were the teacher, how would you discuss this with the class? Choose one response from the list below. A. Explain to students that our heart rate is always a range instead of a specific number.. B. Ask students the possible reasons for the differences in people's heart rates. C. Ask students to consider the variations within their class data and explain why they are different. D. Invite students to plan an investigation to identify the range of heart rates for two different age groups. E. Other actions you may take (please describe below).
video 6	DLU(Science)	Students had to devise activities to increase their resting heart rate by 50%. In this video clip, the teachers are talking about their conversations with students about designing a 'fair' procedure to increase their resting heart rate by 50%. Please watch the video.		If you were the other teacher, what would you say in response to your colleague? Choose one response from the list below. A. This is a problem. I think we need to stop the class and explain clearly to the students that they need to measure their heart rate before and after their activity.. B. Let's stop the class and find out from the students how they are measuring heart rate. C. Let's take this up with the students in a discussion at the end of the lesson/beginning of next lesson when we look at their data together.. D. Let's go on and have a chat with each group to find out what measurements they are taking. E. Other actions you may take (please describe below)

Results of individual/group review of student artefacts

Step 1 Independently viewing the two lesson videos to identify students' mathematical and scientific thinking that challenges teachers' ability to respond to students.

Step 2 Using a spreadsheet to record our critical moments, connection to theoretical framework and possible open items.

Student's artefact

Student	Artefact	Description	Possible question	AE component
S9		S9's measuring results for walking and running are the same.	Q. What do you think about Jason's worksheet? Could you tell us the reason? Q. Could you tell us if you have any strategies at the moment or after class?	Deep level of understanding Flexibility(change the activity depending on students' response)

Results of individual/group review of student artefacts

Step 3 Team meeting to compare selected challenging moments and discuss and relate these moments to theoretical framing of AE.

Step 4 Compiling possible video extracts to a common list for final discussion.

Individual review by 3 researchers

Group discussion by 3 researchers

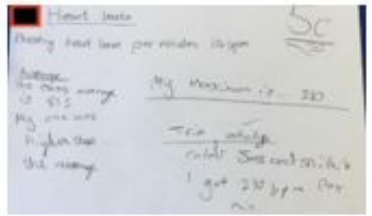
Group discussion by all researchers

Student's artefacts									
Activity worksheet					reflection statement				
	Week 1	Week 2	Week 3		Q1	Q2	Q3	Q4	Q5
Responses	14	16	15		18	18	18	18	18
1st group selecting (5)	2	3	1				Q3(5)		Q5(5)
2nd group selecting (4)	1	1	1						Q5(3)
Final selecting (3)	1	1							Q5(2)

Results of individual/group review of student artefacts

Step 5 Team meeting to discuss question structure: MC vs Open-ended.
Drafting of multiple-choice items with audio explanation (Phonic) for the video extracts.

Step 6 Team meeting to make final selection of video items and the wording of MC options for each item.

	Item	AE(Field)	Descriptions	video & worksheet	Multi-choice answers
1	Josiah's worksheet	Flexibility	Shown here is Josiah's worksheet. This includes the resting bpm (top), the predicted bpm and the measured bpm after walking, star jumping, running, and belly breathing for a minute. There are significant discrepancies between predicted and measured heart rates. Please look at Josiah's worksheet.		If Josiah is a student in your class, how would you respond to this worksheet? Choose one response from the list below. A. Explain that they must have made mistakes during measuring. B. Ask them to explain their predictions. C. Ask them to explain the discrepancies between predicted and measured heart rates. D. Ask them to explain in detail how the heart rates were measured and calculated. E. Other actions you may take (please describe below).
2	Jack's worksheet	DLU(Science)	Shown here is the worksheet of Jack. This includes their resting heart beats (top), the class average of bpm and their own bpm compared to the class average (left), and their own maximum bpm (right). Jack's resting heart beat is higher than the class average.		If Jack is a student in your class, how would you respond to this worksheet? Choose one response from the list below. A. Explain that every person's heart rate is different. B. Ask the student how and when they measured their resting heart rate. C. Ask the student to compare their resting heart rate with that of the other students in their trio.
3	STEM Q	Deliberate practice	Shown here are the written responses of two students to the question: "How did we use mathematics/science in these lessons to help us understand something about our bodies?" They responded to this question after completing the lesson sequence. Please read their responses.	Polly: "We used math by finding averages, and adding and multiplying numbers. We used science by finding places on our bodies where we could measure our heart rate." Muhammad: "We used basic math like averaging to find our avg bpm. And we used science to increase/decrease our bpm! We would experiment on different methods that increased/decreased our bpm!"	As the teacher, how would you try to promote these students' understanding of the connection between mathematics and science? Choose one response from the list below. A. Explain to students the elements of maths and science that were missing in their answers. B. Explain the connections between maths and science to students. C. Ask these students what else they had learned about their bodies. D. Ask these students whether they see connections between maths and science. E. Other actions you may take (please describe below).

An example of the final version of an item

After students measured their resting heart rate, they had to predict and measure the change in their heart rate as they undertook various activities such as walking, star jumping, and running. In this video clip, the teacher is responding to a student who has just calculated their bpm after walking for a minute, before doing star jumps for a minute. Please **watch the video.**

An example of the final version of an item

What response or question would you have used when interacting with this student? Choose **one response** from the list below.

- ◯ A. "What did you find out?"
- ◯ B. "What do you think about your prediction for heart rate for star jumps?"
- ◯ C. "Do you think your heart rate for star jumps will be higher or lower than for walking? Why?"
- ◯ D. "I think you should change your prediction for star jumps, don't you?"
- ◯ E. Other questions you may ask (please describe below).

Why did you choose this response and not the other responses? Please audio record your **verbal explanation.**

Powered by Phonic

Work in progress on rating

- Considering reliability and validity
- Matching each response with a level of AE and to define these levels

	Selection of options	Teacher's responses
T1	A. "What did you find out?"	It is currently unclear if the student has compared her results to her prediction. I would ask the student to explain her results and ask what she has observed. I would expect the student to explain how close or far off her prediction was. I would leave it up to the student to decide if they wanted to change predictions. Or, I would use that time for a whole class discussion "what have we discovered?" Students may discuss that their predictions are far off and may elect to change and make another prediction informed by their first test.
T2	A. What did you find out?	This is the most open ended question. It allows the student to think for him or herself. I would then follow up with more probing questions.
T3	B. "What do you think about your prediction for heart rate for star jumps?"	I would choose this response ("What do you think about your prediction for heart rate for star jumps?") to allow the student to think open-mindedly, rather than give them the ideas.
T4	B. "What do you think about your prediction for heart rate for star jumps?"	I would ask them to talk through how they came to that prediction. What was their thinking behind their answer. Illicit more information and lead them back on track through more questioning.
T5	C. "Do you think your heart rate for star jumps will be higher or lower than for walking? Why?"	No response

Questions?

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Thank you!

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