

Teacher roles during inquiry-based teaching in the early-years

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Abstract

Many teachers are at a loss when required to use inquiry-based teaching / learning in their classrooms. Yet, most teachers would agree that investigative science via inquiry based teaching and learning is a highly effective way to teach science. Students build their scientific understanding and investigative skills through scientific inquiry where they make connections between prior knowledge and new ideas – but what role does the teacher play in this? There is a long list of authors who describe inquiry-based lessons in classrooms. However much of this is in relation to the student during the inquiry teaching / learning process (e.g. the Learning Cycle; 5E's and 4E x 2), with scant research available providing a description of the role of the teacher. The descriptions that are available are quite broad and possibly of little use to a teacher who is seeking a detailed or step by step guide for open inquiry pedagogies. This paper will therefore use classroom studies to describe, the role of the teacher in the initial stages of an inquiry based teaching / learning project.

Keywords: Teacher roles; Inquiry-based teaching and learning; early years; science

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Introduction

There is a long list of authors who describe science inquiry-based lessons in classrooms. However, much of this is in relation to the student during the science inquiry teaching / learning process (e.g. the Learning Cycle; 5E's and 4E x 2), with scant research available providing a description of the role of the teacher. The descriptions that are available are quite broad and possibly of little use to a teacher who is seeking a detailed or step by step guide for open science inquiry pedagogies. Windschitl (2003) describes scientific inquiry as a process "through which students form their own questions and conduct independent investigations" (p. 114) – but the question is asked: What role does the teacher play in this?

Over time, the attempts have been made to consider the role of the teacher during the science inquiry process but it is problematic in that it lacks detail. Wells (2001) described the inquiry process as three separate activities the student needs to do – research, interpret and present. The role of the teacher is described in broad terms of being a co-inquirer facilitating collaborative talk – but how does the teacher enact this? Zubrowski (2007) describes the inquiry process as three phases – exploratory, evidence gathering and sense-making, plus two transitional phases and the teachers' role to be that of a collaborator and that the teacher acts as a resource – but again, how does the teacher do this? In the Asay & Orgill (2010) research, the suggestion is made that the student needs to initially participate in two concurrent activities – to question and to find evidence. Once evidence has been found, the student needs to then analyse the evidence making connections between pieces of evidence. The student then needs to communicate their inquiry project and findings. Again, the role of the teacher is described in broad terms of appropriately scaffolding ideas and activities, asking questions and contrasting students' ideas with the ideas of scientific community. Combined, the literature suggests that the role of the

teacher is one where, as a co-inquirer, the teacher collaborates with students, and through the asking of questions, scaffolds the development of student ideas to be compared with ideas from the scientific community. The teacher takes students through five sequential phases during the inquiry process. Three Phases (Exploratory, Evidence Gathering and Sense-Making) are critical to the teaching of inquiry lessons; however they will not be fully influential on learning without the two Transitional Phases.

Although the teacher's role is described in broad terms in each study noted above, this is of little use to a teacher who is seeking a detailed or step by step guide for open inquiry pedagogies. This paper will therefore use classroom studies to describe, the role of the teacher in the *Exploratory Phase* of inquiry based teaching and learning. Asay and Orgill (2010) cite a long list of authors indicating there is a need for descriptions of actual inquiry-based lessons in everyday classrooms.

Methodology

This paper presents a vignette case study from a larger study. The larger study collected classroom data consisting of teacher interviews, classroom observations, and videotaped recordings of science inquiry-based lessons. The lessons were from nine different teachers and their classes in four schools. Each class had three consecutive inquiry lessons videotaped on three separate occasions during a school year (resulting in 81 videotaped lessons). These videotapes were analysed for determining teacher roles and inquiry-based pedagogies, and then used for stimulated recall in teacher interviews. Details of the participating classrooms are shown in Table 1. The vignette case study presented in this paper is from Primary School 1, a Year 2 class of 25 children, aged between 7 and 8 years old. The class had begun the school year 2 weeks previously, and were undertaking a 10 week thematic unit on "Nursery Rhymes".

Table 1. Participating classrooms

School	Class	Science topics explored
Primary School 1	2 x Year 2	Friction , poisons, swimming safety
Primary School 2	2 x Year 6	Insects, friction, sound
High School 1	2 x Year 9	Flight, digestion, catalysts
High School 2	3 x Year 11 (Biology)	Osmosis, DNA, physiology

Findings

Figure 1 provides a vignette describing the impetus of the scientific inquiry that occurred in Mrs V's classroom in Primary School 1. Mrs V is a young teacher beginning her 5th year of teaching. Her

previous classes had been in Year 2 for her first year in the profession, and then in Year 5 for the past 3 years. She had returned to Year 2 teaching two weeks prior to the following vignette.

Jack and Jill Vignette

The teacher and 25 children were seated on the carpet at the front of the classroom. The teacher had a Big Picture Book of Nursery Rhymes that she was reading with the children. Her thematic unit for the school term had been designed with a literacy base, and she had the intent of using the current lesson to determine the rhyming knowledge and skills of her new class. Together they were reading their third nursery rhyme – **Jack and Jill**.

**Jack and Jill went up the hill
To fetch a pail of water.
Jack fell down and broke his crown,
And Jill came tumbling after.**

During the discussion of the ‘down’ and ‘crown’ rhyming words, one child (Matty) raised his hand and asked: “Mrs V, umm what is the hill made of?” Mrs V proceeded to probe Matty for the source of his question:

Matty: Well, umm there is the hill and Jack fell over. So I’m thinking was it a hole or a cliff even to make him fall?

Mrs V: I’m not sure Matty what the hill was made of. What does the picture tell us?

Matty: It has grass, but that doesn’t make me fall over. And see, Jill is tumbled too. Why? What happened? Why?

Mrs V: Gosh I just don’t know. Does anyone know what happened and why? [wait time] No? Okay then, let’s see if we can find out. What do we know about hills?

Figure 1. Vignette of science inquiry impetus

Initiating the science inquiry process

Mrs V often used the narratives in rhymes and songs in her teaching. She is a firm believer that the classroom needs to draw on the home experiences of the child, and most children are familiar with nursery rhymes. She uses this familiarity base to develop trust in the classroom (“the class is a safe place to be yourself” [Mrs V, Interview]) and as a starting point for her scientific and technological activities. In the case of this particular inquiry process, Mrs V decided the class could attempt to answer Matty’s question “What is the hill made of?” Together the class discussed the variety of hills and mountains the children knew of, and then looked at a hill’s characteristics (it was a slope, it might be steep, some had roads, some had trails for walking). It was the walking trail characteristic that Mrs V use to direct the class further on their quest. She had the children draw walking trails they had experienced paying attention to what they might see if they looked down at their feet as they were walking on the trail.

It’s important to direct the child’s attention to a specific thing, because if you don’t, they will tell you all about something not relevant, so like the sky, or

birds in a tree or flowers. But telling them to draw in relation to their feet, we should get an idea of the trail in terms of gravel if man-made, or compacted dirt if just worn down sort of thing. [Mrs V]

A discussion of the drawings revealed many different types of trails had been experienced or imagined by the children. All were ‘bendy’, and going around rocks or a tree, and in one case “it’s going around nothing much, but has to go around because that makes you go slower on the way down, like people brakes” [Justin]. The trails sometimes had grass growing along the edges, sometimes grass grew in tufts on the trail itself. Some trails were made of gravel and some were dirt. Mrs V then used a brief discussion of these drawings, Justin’s comment about needing “people brakes”, and the earlier notion that hills were slopes and might be steep to close the lesson. The class were informed that Mrs V would talk to a few people about making a ‘hill model’ so that the class could continue to work on answering Matty’s question “What is the hill made of?”

The scientific inquiry process over time

Mrs V and her class used a set of wooden ramps she created to represent the “hill and trail”. In small groups, the children would affix various materials to represent a variety of hill and trail surfaces (e.g. rough sand paper represented gravel, wet potters modelling clay represented slippery clay soils). Over time, the class investigated friction, forces, motion, pushes and pulls in their quest to discover “What is the hill made of?” and why Jack fell. The extensive role of Mrs V as a teacher during this six week scientific inquiry process depicted in Figure 2.

Questioning and exploring the children’s prior knowledge of hills and trails engaged the children. In most cases the scientific inquiry question is negotiated and developed by the teacher and students alike, but in this case it stemmed from a one child – Matty. The question was of interest to the child, and not a teacher posed idea or interest. Following the

shared experience of exploring the research question and possible methods of exploration, Mrs V needed to adopt two simultaneous roles. One was the creation of groups and allocation of group roles. The second was the allocation of materials. Whilst the children were working at ‘answering’ Matty’s research question, the Mrs V needed to keep a check on each group and individual. She needed to openly interact with each group, asking questions of the children; probing understandings, further developing the ‘trust’ atmosphere in the classroom. It was also necessary to keep updating the class of the successes of other groups as a means of keeping the class on task as a whole. There was a cycle of checking Mrs V had to follow multiple times each lesson, which involved keeping students on task, the checking of their progress and maintaining a watch full eye on the “hills and trails”, and maintaining a tidy workplace.

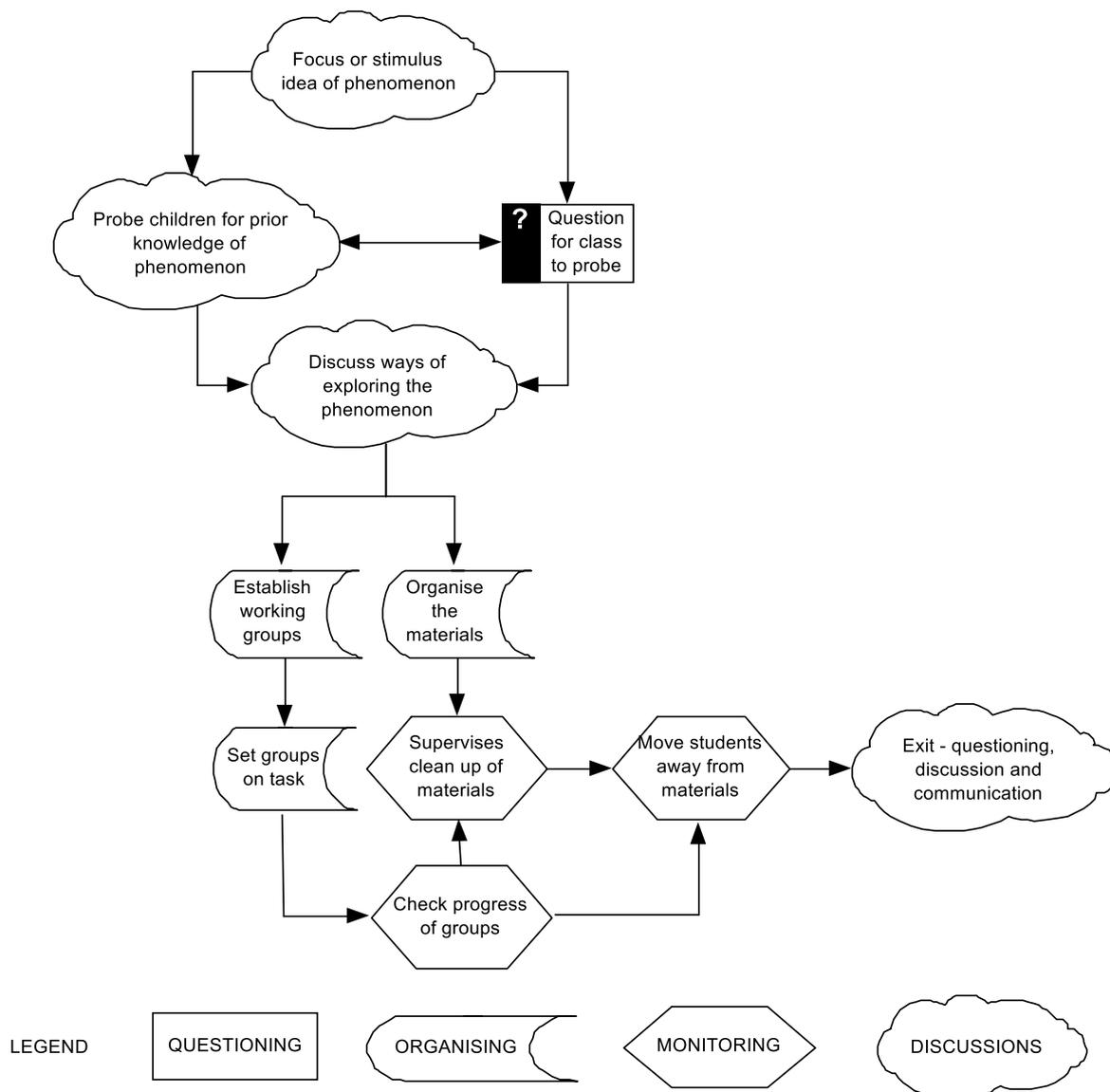


Figure 2. Mrs V’s various roles during the scientific process

Mrs V directed the clearing away of all “hills and trails” after each lesson. It was the students’ responsibility to clear away the work areas – rarely did Mrs V do this. Mrs V was the director of the process, posing questions to the class as they returned materials and attempted to clear work areas. Clearing away time, is quiet time where specific individuals speak when called upon. Mrs V used the time to pose questions to the class who responded as called upon. This discussion was very important as Mrs V used the time to establish discussion within the classroom, and then to continue the discussion once the class has been moved away from the tidied materials.

The theorising

When the role of Mrs V was considered in conjunction with the other eight teachers in the larger study, the teacher role during the scientific inquiry process can be summarised in terms of that of as a questioner, an organiser and a monitor. In Table 2,

Mrs V’s actions illustrate each of six roles. The stimulated recall interview with each teacher utilised the video recording of the three consecutive lessons on three separate occasions. The teachers were asked for explanations of their actions. Of interest was a deeper understanding of why a teacher did what they did, and how they interpreted the overall experience for themselves as a teacher and personally. This notion of personalising the scientific inquiry experience was included as Harwood, Reiff and Phillipson (2001) explain that the extension of personal knowledge and understanding of the world is as important to the teacher as that of the content knowledge and understandings itself. As the teacher takes the approach of developing the child’s skills and habits of mind, the teacher does in fact develop these same skills and habits of mind in themselves – thus adopting the mind-set inherent in a scientists’ conception of scientific inquiry – a state of being where community knowledge and understanding is valued and new knowledge is created.

Table 2. Teacher pedagogical roles

Pedagogical Role	
Questioning	1. That of <i>motivator</i> – Mrs V encouraged her students to take responsibility for their own learning
	2. That of <i>diagnostician</i> - Mrs V gave her students the opportunity to express their ideas in order for her to discern their understandings
Organising	3. That of <i>guide</i> involved Mrs V directing her students and helping them develop strategies.
	4. That of <i>modeller</i> involved Mrs V showing the attitudes and attributes of scientists by example
Monitoring	5. That of <i>mentor</i> involved Mrs V supporting her students in learning about scientific work.
	6. That of <i>collaborator</i> involved Mrs V and the children exchanging ideas, and allowing the children to take on the role of teacher.

When consideration is given to the personal, this gives rise to an additional conception of the role of the teacher. In Table 2 I have considered the teacher roles in terms of pedagogical actions. These actions and roles relate to the teacher having the *Role of a Scientist: by example*. However, if the personal learning lens of Harwood, Reiff and Phillipson (2002) is considered, then the teacher is teaching the

scientific inquiry process with a complementary role – that of having the *Role as a Scientist: of one’s self* (see Table 3). Thus, the experienced teacher of scientific inquiry moves between ten distinct roles as they question, organise and monitor their students.

Table 3. Teacher personal roles

Personal Roles	
<i>Of Scientist: by example</i>	1. That of <i>motivator</i> - take responsibility for their own learning.
	2. That of <i>diagnostician</i> - to express ideas to discern their understandings.
	3. That of <i>guide</i> - directing students to develop strategies.
	4. That of <i>mentor</i> - learning about scientific work.
	5. That of <i>collaborator</i> – exchange of ideas, students to become the teacher.
	6. That of <i>modeller</i> - attitudes and attributes of scientists by example
<i>As Scientist: of one’s self</i>	7. That of <i>experimenter</i> - trying out new ways to teach and assess
	8. That of <i>researcher</i> - evaluating own teaching and engaging in problem solving.
	9. That of <i>learner</i> - opening oneself to learning new concepts.
	10. That of <i>innovator</i> - designing instruction by using new ideas.

Conclusion

An experienced science inquiry teacher, like Mrs V, has the ability to notice an opportunity for an unplanned science inquiry, and to turn this opportunity into a worthwhile learning experience for the student but also for themselves. It is critical that the teacher provides an opportunity for scientific inquiry as the process of a scientific inquiry builds trust in the classroom, allows the students to take risks with their ideas and learnings. Skills and habits of mind are developed in both the student and the teacher. As has long been purported in the literature, it is important that the teacher reflects upon their teaching. Such reflections during and after a scientific inquiry give rise to the teacher being aware that they are both modelling the role of a scientist, as well as being a scientist. This latter role is important as it recognises the personal growth the teacher undergoes as a component of their teaching. Like Mrs V, the experienced teacher of scientific inquiry moves juggles up to ten distinct roles at any one time as they question, organise and monitor their students. This is not an easy task, but is manageable, even with very young children, provided trust has been established in the classroom, and provided all participants have a quest for new knowledge, not previously known.

Epilogue

Dear Reader, if are you wondering what the findings were to Matty's question "What is the hill made of?" please read on. Mrs V and the children were able to make two conclusions, and in the spirit of true scientific inquiry, the findings led to a further question. **Conclusion 1** related to Jack. According to Elizabeth, "Jack had filled the bucket with water but spilt quite a lot. This spilt water wet the clay-soil making it very slippery. Jack slipped over and bumped his head, and that broke his crown". **Conclusion 2** related to Jill. According to Michael,

"Jill had gone tumbling after Jack, so this was a tumbling move going forward. So Jill might have tripped on a big rock sticking out of the clay-soil, or she might have been pushed from the back making her tumble forwards, or she was just doing summersaults ... umm ... I can't decide". **Further Question** was asked by Jessy: "Did the person who pushed Humpty Dumpty also push Jill?"

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