
STUDENT PARTICIPATION: PHENOMENON AND ANALYSIS

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Students' participation in classroom activities is considered to constitute cognition, and is evidenced in student-teacher interaction. In this paper, elements of the complex phenomenon 'student participation' are described with reference to an episode where a student was discussing her solution of a three-dimensional vector problem with her teacher. The multiple-paradigmatic research method used is considered in relationship to how the episode has been portrayed, and is proposed as being suited for both the teaching and research purposes of a teacher-researcher.

INTRODUCTION

This paper reports the beginning of an ongoing study where students' classroom participation is being explored. The study has started with mapping the nature and development of students' participation, and observing students' associated cognitive outcomes, over 18 lessons, when students were learning a topic on three-dimensional vectors and I was the teacher. The problem that initiated the research was that, in the past, my students have had difficulty understanding some of the abstract vector concepts that are part of the Year 11 Geometry and Trigonometry course in Western Australia, and the literature (Dreyfus, 1994) suggests other students have similar difficulties.

The teaching/research agenda of encouraging students' classroom participation was in order to explore the suggestions that the learning processes of *participation*—knowing socio and socio-mathematical practices (Cobb, 1998), and *acquisition*—developing personal understanding (Sfard, 1998), are inter-related, and that both metaphors should be adopted for teaching and research: "Each has something the other cannot provide. . . . When two metaphors compete for attention and incessantly screen each other for possible weaknesses there is a much better chance of producing a critical theory of learning" (Sfard, 1998, pp. 10-11). To motivate students' participation, I adopted a problem-centred learning approach (Wheatley, 1993) where students worked together on 'real-life' problems to develop their understanding of three-dimensional vectors.

One challenge was to establish a research methodology that did not interfere unduly with my teaching, but instead informed it. The personal experience methodologies of hermeneutic phenomenology (Pinar & Reynolds, 1992; van Manen, 1990) and narrative inquiry (Connelly & Clandinin, 1988), and the attitude of 'reflective practitioner' (Schön, 1987) guided, and continue to guide the research. This paper describes the research method that emerged early in the study. The method is discussed in relationship to an episode where I was working with a student on a one-to-one basis, during the first lesson on the vector topic. Discussion of the episode illustrates how I used the literature to explicate the nature of participation as experienced in the classroom, in order to refine my research/teaching focus. The purpose of the paper is to illustrate how personal experience research methodologies can be used to develop understanding of professional practice from both teaching and research perspectives.

THE RESEARCH METHOD

Simply, hermeneutic phenomenology (van Manen, 1990) is experiencing a phenomenon and interpreting it through writing, while narrative inquiry (Connelly & Clandinin, 1988) is writing about experience over time. The methods of data generation, the quality criteria and the theoretical framework for my interpretive inquiry are provided below.

Data Generation

The site of the teaching/research was a private, all girls' college in Western Australia. The sources of data were seventeen students in a Year 11 Geometry and Trigonometry class, myself as their temporary teacher replacing their regular teacher who was on leave, and a colleague who was teaching a parallel class. All eighteen lessons on three-dimensional vectors were video-taped from a back corner of the room, with the video-recorder set to record continuously. The dialogue on the video-tapes was transcribed. A journal was kept, recording my impressions of lessons and conversations with the teacher of the parallel class, with whom I discussed the teaching and learning outcomes. Other data, which have been used minimally for what is reported here and are not described in detail, were student responses to three questionnaires, interviews with students. As well, students' worksheets were collected and photocopied.

Quality Criteria

For a personal-experience research approach, van Manen (1990) suggests that to "render a human science text a certain power and convincing validity . . . our texts need to be orientated, strong, rich and deep" (p. 151). The episode that is presented here is orientated around the research question "What *is* participation?" and, while writing it, I paid attention to the student it concerns, in what I see as an honest way so as not to misrepresent her. The criteria I used were that the portrayal of classroom life is strong, believable and coherent and, as a check that this episode and others 'rang true', I adopted McNiff's (1995) suggestion to have a critical friend, a past teaching colleague read them.

A Framework for Interpreting Classroom Interaction

As the reader, you may choose to refer to the next section as you read this one, because the classroom episode that is described there contains (a) text-boxes indicating theoretical perspectives, which describe components of the writing. In the episode, my experiences are represented with (b) conversation sequences from the video-transcript and with (c) reflective comments. The episode itself is broken into segments, each accompanied by (d) a discussion in terms of the literature. In addition, (e) my interpretations of elements of 'participation' are inserted in italics into the discussion, an approach I adopted from reading Lakoff & Johnson (1980). The italicized inserts are intended to capture the elements of participation in the paragraph they are attached to, and as thought provoking for the reader. They contributed to the description of 'participation' in the conclusion.

The lines of dialogue that form the basis of the portrayal of the episode are from the video-transcript and are linked together with comments, e.g., 'Jane continued...', rather than being reported in the bald form usual for research reports. This linking is to make for smooth reading as in the genre 'short story'. Some of the comments are a record of my pre-reflective perceptions (Pinar & Reynolds, 1992) and reflective responses while living the classroom experiences, which I re-viewed or re-lived by watching the video recording. The episode or story, therefore, expresses personal 'knowing-in-action' and 'reflection-in-action' (Schön, 1987), where action includes conversation. The text also includes elements of 'reflection-on-action' (Schön, 1987), reflection which involved looking back at the incident, but which didn't impact on it.

I purport to portray only one of the many possible realities of the classroom: the voice of a teacher at a particular time, the time of writing the account. This research approach is in accordance with a constructivist epistemology (Noddings, 1990; Taylor, 1998) and assumes understanding is personal: that there are multiple realities for any event, none privileged over others.

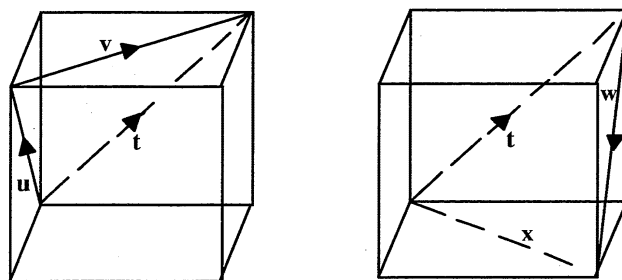
However, interpretation did not rely solely on personal experience. My classroom experience was shared with students. There was shared meaning in our participating in conversation and activity together. This shared understanding can be cast in terms of the constructionist metaphor of mind “actors in conversation” (Ernest, 1995, p. 482) where understanding rests in the “dialogic space” (Gergen, 1995, p. 46) between the actors. Resting in space implies understanding that wasn’t personal. It was ‘knowing in participation’ (Sfard, 1998), in co-ordinating our interactions with each other. Elements of this knowing are evident in the comments that are used to link the lines of transcribed dialogue in the episode.

THE EPISODE: STUDENT-TEACHER PARTICIPATION

The episode illustrates a student’s difficulties when the class was involved in small-group problem solving. The student was working by herself, as her working partner was absent. First, the problem (Schools Council, 1978) that students were working on is provided so that events can be followed by the reader.

A VTOL (vertical take-off and landing) aeroplane, in a display of precision flying, is to take off at an angle of 45° in a vertical plane, which has a bearing of 180° (vector \mathbf{u}). After flying 100m it is to turn, and fly horizontally for 100m on a bearing of 045° (vector \mathbf{v}). The final movement is to land at 45° to the horizontal, again flying at 180° (vector \mathbf{w}). What is the resultant \mathbf{x} , of the vector addition $\mathbf{u} + \mathbf{v} + \mathbf{w}$. Give the magnitude and direction.

Figure 1
Diagram Provided with the Problem



I was helping Cheryl interpret the diagram for the problem. Jane, who was sitting in front of Cheryl, turned around to join in.

I was saying:

“You have to work out where it [the plane] ends after the three legs [of the flight path]”, when Jane, pointing to the angle that \mathbf{x} made with the lower back edge (see Figure 1), asked:

“Will it be 45° ?”

I answered:

“Yes”, then paused, unsure, and continued:

“Yes, it will be 45° because they are equal. But will it? Not necessarily?”

Jane asked:

“Isn’t it a cube?”

Reflection-on-action.

I had been thinking of individual vectors each framed by a separate face of the figure, rather than viewing the figure as a whole, so now had to switch to Jane’s approach:

“But here you have got a diagonal, not a side of 100. No it’s not a cube. Why isn’t it a cube? Or is it?”

Jane was certain:

“It’s a cube”, but I was still doubtful, replying:

Knowing-in-participation.

“Okay.”

Jane argued:

“The diagonals are equal”, convincing me she was right:

Reflection-in-action

“Okay. Yes it is, because all the diagonals are equal.”

Participation is negotiation.

Gergen's (1995) social constructionist view is "what we count as knowledge are temporary locations in dialogical space" (p. 30) and he suggests that:

authority [for knowing] is socially accorded, and within most academic spheres it is typically given to those occupying a given discursive position. Thus, anyone may be an authority who occupies the position, if permitted to do so by a relevant social group. The ideal in this case is not knowing that something is the case, but knowing how to produce language that will be accorded status. (p. 31)

In being able to articulate her knowing that the figure was a "cube", Jane shifted the authority from me to herself. Her seeing the diagram as a cube, instead of as separate sectors of the flight path, potentially reduced the cognitive demand of the problem because of the geometric properties that might be assumed: Eylon and Lynn (1988) describe how the "working memory demands of problems" (p. 266) are different for students according to the way their knowledge is organised and the "task representation that they choose" (p. 266). However, it wasn't sufficient that Jane recognised the more efficient representation, she had to convince me of it, in order to continue. *Participation is constituted by and constitutes cognition.*

For some, including me initially, a cube brings up the image of a block with edges of equal length and the given information in the question didn't directly satisfy this requirement. Jane established a higher level of thinking by justifying her classification of "cube" with the identification of equal diagonals. My confirmation was a signal for Jane to go on, and implied that we were talking about the diagonals drawn on the faces—that the internal diagonal through the centre of a cube is longer than the other diagonals wasn't an issue. *Participating is interpreting language.*

Jane continued:

"I think it [the resultant vector] goes from there to there."

Element of participation.

I moved forward to see her work, and she explained:

"So that's 100 and it is a bearing of So that's a bearing of 315°."

Knowing-in-action to let Jane try to find her mistake.

She had made a mistake, which I thought was to draw the bearing at the end instead of the beginning of the resultant, so I answered:

"Yes. That's a bearing of 315°. But where do you measure your bearing from?" and she replied:

"From North. From there", pointing to the diagram. Jane talked through her solution again but it was still based on a wrong assumption.

I repeated:

"Yes, that's definitely 315°. I agree with that, but where do you measure bearings from? From." She was sure that she was right, replying:

"North."

I told her:

"From North. Okay. But this is the endpoint (pointing to the diagram). And bearings are measured at the start."

Participating is persevering.

Gergen (1995) again provides a basis for analysing the exchange:

The success of the dialogue depends on one's ability to (a) single out from the others' words (and actions) those elements that can be coordinated to what has preceded, (b) generate words (and actions) that grant to the interlocutor's offerings the status of authority and coherence, (c) extend the preceding patterns of words (and actions) in the dialogue in ways that are useful to the exchange, (d) leave space in the exchange for the other's participation, (e) furnish backchannel information that helps retain the trajectory of the exchange, (f) avoid moves that terminate the discussion (e.g., personal threats, insults), and so on. (p. 34)

Discussion earlier in the lesson had established that bearings were measured from North, which explains Jane's association of 'from' with direction, rather than with position. Despite the misunderstanding, the conversation proceeded smoothly with Jane and myself taking turns at putting forward our ideas and having them acknowledged as authoritative and

coherent. Then, the authority moved back to me with the clarification of what I meant by 'from' and with the suggestion of a source of error: an extension of dialogue, past reiteration, to open up the possibilities for resolving the misunderstanding, but without the termination of an instruction that would directly yield the answer. *Participating is assuming / relinquishing authority.*

Jane argued:

"But that vector is starting from there and goes to there."

Now a different source of error was apparent to me.

"Okay. That's the vector going back to the beginning. But vectors always start at the beginning and go to the end."

She paused, and answered:

"Oh, yes. So we have to do the bearing here?"

"Yes, so you have to go back and adjust your angle."

Participation constitutes cognition.

It turned out that Jane's mistake was not to do with her understanding of bearings, but with the direction of the resultant vector. Later Jane, when asked, explained the solution to the class. Then, issues from the one-to-one conversation with Jane became teaching points: a constructivist attitude resulted in "teacher as learner" (Tobin & Tippins, 1993, p. 9) with an understanding of student difficulties that mightn't have otherwise been considered by the teacher and which might have been widespread. Whether Jane and the class would be able to transfer (Lave, 1988) any new understandings to a different problem was a separate issue. *Participating is being open to others' ideas.*

Jane's involvement could be seen as *competent participation*. "[W]e talk about competent participation. Knowing physics therefore means to participate in *talking* about relevant objects and events in the way physicists do, using acknowledged words, sentences, gestures, inscriptions, and so forth" (emphasis added, Roth & Tobin, in press). Having initiated her own involvement in the discussion, Jane's competence was constituted by mutual exchange of ideas with me: for both of us, " 'I know' when I speak in ways that enable you to treat me as if I know and vice versa" (Gergen, 1995, p. 34). However, competence in Roth and Tobin's use of the word, is more than appropriate use of classroom mathematical language. It is measured by the extent to which *authentic participation* in the mathematising of mathematicians is engaged in. Perhaps the applied problem solving lent authenticity to the classroom endeavors. *Participating is being competent.*

Lave and Wenger (1991) also discuss authenticity or *legitimacy*. Jane's participation was legitimate, in Lave and Wenger's definition, to the extent that it matched the practices of the outside mathematical social world, or alternately was typical of the Year 11 class. Evidence suggests that Jane explaining her solution to the class was not typical of the way lessons had been facilitated with the students' regular teacher: "Like, Mr Brown does the method on the board" (Student Interview). So the criterion of legitimacy, what was normal for the students, might not have been met in the lesson. *Participating is being adaptable.*

In the collaborative achievement of solving the problem, learning was mutual, not of the synthetic type where I had worked the problem previously and 'held back' to allow students to explore it, but instead Jane and I genuinely sorted out the detail together with control shifting between us. My not bringing a prepared solution perhaps encouraged teacher-student *co-participation* (Lave & Wenger, 1991), where co-participation is learning in partnership through conversation or activity, which is enhanced by the absence of teacher domination (Taylor, 1998). Gergen (1995) describes how, in preparing for lectures, the "hours of preparation—the rereading of texts, scanning of notes . . . are essentially removed from student view. Such removal is essential, of course, in sustaining the myth of authority as an individual possession: 'My lecture demonstrates the superiority of my mind' " (p. 31). A teacher in a secondary-school classroom having content worked out to the last

detail might have the same effect that Gergen describes for the lecturer. *Co-participation is a symmetrical relationship.*

However, Schoenfeld's (1996) experience suggests that what matters isn't a teacher's lesson preparation but the way the lesson is played out. He compares his group-sessions with post-graduate students where he is "frequently at the limits of my competence . . . nor am I usually on familiar turf" (p. 11) to his problem-solving, undergraduate course where he is on "familiar ground most of the time . . . and even if the students don't know where they are going, I usually do" (pp. 11-12). His aims for both groups include authentic participation: "I want my students to emerge as skilled practitioners of the discipline . . . [and he suggests that] in a particular kind of environment, the acknowledged artifice [of the instructional approach] can become irrelevant, as can the question of whether the instructor knows 'the answer' " (p. 12). Although his two teaching environments are different, Schoenfeld feels there are many similarities in the outcomes for both, and attributes this in his problem-solving course to: "The atmosphere is open; the students are generating ideas that are fresh to them; and I am working on the spot with what they generate" (p. 14). *Participating is being listened to.*

Jane's persistence and motivation to solve the problem and to engage in discussion of it did not seem to be hampered by the abstractness of the worksheet diagrams, which were void of angles, lengths and compass directions. For her, the diagram acted as a *coherence object* (Roth & Tobin, in press) around which she negotiated her understanding. In contrast, analysis of other episodes suggests the limitation of the diagram acted as a *boundary* or *border* (Roth & Tobin, in press) to some students participating as successfully as Jane: they couldn't interpret the diagram in order to discuss adequately the problem. *Participating is interpreting inscriptions.*

Lave and Wenger (1991) discuss learning in terms of apprenticeship so that in a classroom the teacher is seen as the *expert* or master and the students as *peripheral participants*. The expert, taken to mean the person with wider knowledge or more experience, enculturates students into mathematising practices. In this first lesson it seemed as though some students, like Jane, were already nearly experts in the practices (explaining, justifying and listening) of a mathematics classroom. Yet, I wrote initially about others rather than Jane, not recognising the efficacy of her involvement. *Participation is present in every classroom but varies in quality.*

CONCLUSION

In summary, What *is* participation? Briefly, participation involves taking part with others: working together, one speaking, another listening, taking turns and waiting. It is evidenced in language and in action or gesture. It can centre on inscriptions such as diagrams and algebraic formulations. Not understanding the language and accepted actions, or the inscriptions, can be barriers to an individual participating. Participation moves through time: it is initiated, engaged in and terminated. It goes hand-in-hand with mental activity: cognition, interpretation and making sense. It concerns emotion and attitude: being motivated and confident. Participation can be legitimate and/or authentic and can vary in quality measured by relevance and coherence. It concerns and disperses authority. Input might be mainly from one party or it might be co-participatory, with contributions spread across a group. Last, participation can result from both taking and making opportunities for involvement.

After looking at the episode related above, and at others from the first lesson, the question for me was: What sort of participation is desired by the teaching goal of working towards students' active participation in classroom activities? What captures the essence (van Manen,

1990) of the phenomenon 'optimal participation' in the way that Noddings (1990) classifies students' cognition as strong? Perhaps it is that participation is voluntary and constructive. Voluntary to the point that if a student has ideas or understanding that might benefit the group, then she shares them, and constructive in that it adds to the understanding of the group, or is part of a process of a student developing confidence. Exploring the nature of students' participation in the first lesson with the Year 11 class, allowed me to define that voluntary and constructive student participation was one of my teaching objectives and was a forerunner to encouraging its development and inquiring into its relationship to students' cognition of vectors.

Schön's (1987) epistemology of practice, which encourages reflection while engaged *in* teaching and reflection in retrospect *on* teaching, and the research methodologies of hermeneutic phenomenology (van Manen, 1990) and narrative inquiry (Connelly & Clandinin, 1988) continue to enrich my understanding of teaching and learning processes. Other teacher-researchers may find the methodologies similarly accessible.

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