How was it for you? The dialogue between researcher and colearner

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Abstract

Detailed enquiry into the learning process requires in-depth case studies of individual learners, which involves the 'subjects' in considerable time commitments, and the risk of exposing their personal limitations as learners. Case studies into learning can be informative for the researcher, but could also be threatening to the researched. The present paper considers a research project where a key principle was that the 'research subjects' should feel that they were benefiting from being involved in the research. The students who committed time to the project were considered to be colearners. The core of the paper is a dialogue constructed around one colearner's comments, as a narrative device to illustrate the frustrations and rewards of being the 'subject' of the research process. The extent to which the composed text can be considered to represent the authentic voice of the colearner is discussed.

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[1] Tajinder is the assumed name for a colearner in the research. He was studying chemistry as one of his 'A level' subjects in a further education college at the time the data was collected. He went on to successful University study.

Prologue: a research briefing

A college student (taking an A level course in a Further Education college in England) volunteered to take part in a research project intended to investigate learners' developing understanding of a scientific concept. At the start of the first research interview he was read a brief statement about the nature of the research process,

> "I am going to start by explaining the purpose of this interview, and then I am going to ask you some questions about yourself. After this we will check if the tape has picked up your voice clearly. Then we will do the main interview.
>
> I am conducting some research into how students learn about chemistry during their A level course. I'm going to show you some diagrams, and ask you some questions about them. I want to explore your ideas and your understanding, so I will often follow up your answers with more questions, and I may challenge you to try and explain your ideas.
>
> In order to probe your ideas I will not be judging your answers as right or wrong, but will try and explore what you really think. So I may seem to go along with answers that I don't think are quite correct, and I could seem to disagree with others, even if I really agree with what you said.
>
> I'd like to thank you for volunteering your time. Your comments will be treated as confidential, and if included in any reports will be used anonymously. The interview could last up to one hour and I may need to turn the tape over at some stage. Please let me know if you want to stop at any time. I would now like to check that your voice can be heard clearly on the tape, so please would you state your name?
>
> Keith

It is necessary to stop reporting the conversation at this point, because the student had been promised anonymity. Volunteers were given an alphabetical code, and this student was coded T. He is referred to as Tajinder.

At the end of the first research interview Tajinder was debriefed,

> Keith: I'd like to thank you for your time and letting me discuss your ideas. I found that very interesting. How did you feel about that?
>
> Tajinder: It was all right, it just like made me realise that I didn't know as much as I thought I did. Or trying to - I don't know - just like confuse me a bit. I dunno if it was meant to do that. I think it was.
>
> K: Well, I'm not sure I'd say it was meant to confuse you as such.

T: I think it just like points out what you know and what you don't know clearly. I don't think I knew that much.

K: Mm, but I'm asking you because we're doing A level chemistry.

T: Right.

K: And how much A level chemistry have you done so far? Four weeks?

T: Four weeks.

K: You've got a few more weeks to go yet?

T: Yeah. [laughs]

K: Yeah. I hope you will be prepared to discuss these diagrams again later in the course.

T: All right.

K: So I can see how much your understanding develops.

T: Uh huh.

K: And I'd also like you to undertake some other, similar tasks for me.

T: Yeah.

K: Would you be happy to do that?

T: Sure.

Monologue: the researcher's perspective on the research project

Tajinder was one of a number of A level students who volunteered to be interviewed, and provide other data, as part of the 'Understanding Chemical Bonding' project (Taber 1997). The project was undertaken by a practitioner-researcher interested in studying one facet of the teaching and learning that occurred in his classes. The practitioner is the first author, Keith, who at that time was a senior lecturer in the college where the research was based.

The context for the research was an important scientific concept (chemical bonding) which college students would have been taught something about in their school science, but which had to be developed in scope and sophistication at their new, higher, level of college study.

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The study had an action-research flavour in that Keith was concerned that the appropriate progression in conceptual understanding was not easily achieved by students, and wished to find more effective ways of developing students' ideas in this topic area.

In these terms the project could be considered as a success. The research uncovered aspects of learners' thinking about the topic which were at odds with the scientific model (*e.g*, Taber 1994a, 1998), and this led to suggestions about how the teaching of the topic might be changed (*e.g.*, Taber 1999).

However, *this* paper is not concerned with either the scientific topic which formed the focus for the research, nor with the researcher's own questions about conceptual change and pedagogy: matters which are dealt with elsewhere (for example in the literature just cited). Rather, the purpose of the present paper is to attempt to give voice to the experiences of the other *partner* in the research process (cf. Zajano & Edelsberg, 1993): a student who agreed to give up time, and expose his ideas to interrogation, and thus make the construction of a case-study possible.

The research used a grounded theory approach (Taber 2000a) which collected data from a large number of learners, but relied heavily on case studies of the individuals who volunteered to be interviewed for the project (*e.g.*, Taber 1995, Taber & Watts 1997). The case study of Tajinder was based on the richest data set, and was the source of significant insights about the way learners' thinking about the topic evolved (Taber 2000b, 2001). This data set included tape recordings of over twenty interviews, many of which lasted well over an hour - something that was only possible in the context of both partners to the research process valuing the sessions (see the 'monologue', below).

At the start of the research process a conscious decision was taken to ensure that the study was informed by an 'ethical imperative'. Apart from a belief that all our professional actions should be informed by our ethics, Keith felt that - as a teacher-researcher - he had a *particular* responsibility to ensure that he did not abuse the trust of his informants who were also his own students.

In particular Keith set out to ensure that the informants were assured that their input would be confidential, and that they would be contributing without duress, because they genuinely felt it was worth their while to be involved (Taber 1997). Accordingly, Keith decided to conceptualise Tajinder and the other student-informants as 'colearners' in the project (Taber 1994b, 2002). In practice this meant that Keith felt it was important to make each request for an interview or other input to be

clearly an invitation (cf. Limerick et al., 1996), and that he made a point of asking colearners to provide feedback on their experiences of being involved in the research.

The various reports of the findings of the research include quotations from interviews with colearners (as well as from the written work of these informants) which support the interpretations made in the data analysis. The reports based on Tajinder's case include many examples of his utterances, sometimes at length, in response to questions about his ideas. Tajinder's voice is therefore heard in these reports: but it is a disembodied voice, one that has been subject to interpretation, selection, 'cutting and pasting' and various other indignities of the editing process. Tajinder is not cited as an author of those research papers. They have not been 'authored' by Tajinder, even though they are *about* his words, his ideas, his thinking. What has been done to Tajinder's input has been done with permission, with care, and, Keith would suggest, with genuine affection and respect: but it is an act of the researcher 'using' the words of another as though Tajinder's utterances have become Keith's intellectual property.

In a sense this is exactly what *has* happened. As researcher Keith set up the exchanges, and led them, and engineered the construction of a conversation that would provide the data he needed. Tajinder's words were part of the dialogue, that became recorded on tapes that were used to prepare transcripts that Keith considered his copyright.

We do not suggest that such a process is remarkable. Rather it is the very way that such a process of data acquisition (a term that can imply ownership as well as collection) by the researcher of texts generated by the researched is unremarkable that we wish to highlight by presenting this present paper as co-authored.

In *some* significant ways the present paper is no different to others generated in the project. The writing process has been undertaken by the first author, who has edited Tajinder's words into what he hopes is a coherent narrative. Tajinder is an anonymous partner in the research who does not write educational research papers. However, this paper is an *attempt* to provide a much more genuine voice for the researcher's colearner than is normally possible in research papers.

The theme for the paper is Tajinder's experience of being involved in the research, of his being interviewed and subject to various other episodes of 'data collection'. Clearly this a theme that is 'owned' by Tajinder, and to which Keith comes as an outsider. The data source for this paper comprises of Tajinder's comments made during the debriefings at the end of interviews, and of

notes he made in a diary he was asked to keep during the second year of the research partnership, recording his feelings about the research process.

Keith has edited this material to provide a coherent account of how this particular informant felt as he was probed as part of an education research project. Keith has attempted to allow Tajinder's authentic voice to sound out. Although the mechanical process of writing this text is Keith's, there is a very real sense in which this paper should be seen as being co-authored (cf. APA, 2001). In terms of keystrokes there is a sole author, but intellectual property can not be assigned so simply. Keith is Tajinder's editor: but it is Tajinder's script.

The next section is presented as dialogue. Parts of the section derive from genuine dialogue taken from transcripts of research interviews (these sections are shown in the style at the end of the prologue above, with the speakers' turns shown). However, most of the material derives from Tajinder's diary comments, which are presented as quotations, and among which Keith has interspersed his own text to construct the narrative. (The validity of this approach will be considered in the epilogue.)

Dialogue: How was it for you?: "It was very intense, but afterwards I felt very good"

...before I didn't understand, but now I understand...

Keith: I think you've done very well there. I mean it's almost like you learnt it off by heart, learnt the script or something,

Tajinder: No, it's just that I just remembered it, from Wednesday. 'Cause Wednesday was really good, I learnt like, I think I probably learnt more Wednesday than I did in a few inorganic lessons actually.

K: That's good. But do you understand it?

T: Yeah I did understand it.

K: I mean if you understand it, it's not too difficult to remember.

T: Yeah, yeah that's right. 'Cause the only reason I couldn't remember it before, 'cause when we done, this is [the topic] periodicity isn't it? In the exam I didn't get a very good mark, because I just, I didn't understand why the trends were

happening, but now I understand it, I could like draw that off, like anytime you wanted.

...it was a bit awful, but it made me think...

K: Was that too awful?

T: No, it was a bit awful, but it was all right, it made me think a bit.

K: {laughs} It made you think. It was awful, but it made you think.

T: {laughs} It's all right, I used my brain.

Keith: Some students think that it is better when they can answer questions without too much effort, but you don't seem to mind being really stretched in our sessions.

Tajinder: "Started off with Raoult's law. Discussed mixtures of liquids. Very helpful made me think about the law, and it came back to bonding, which I enjoy actually. Made me think a lot today."

...I had learned about this last year, but today I was able to put it into words...

Keith: You seem to recognise that it is sometimes worth spending time going back to discuss ideas that you had considered you had already learnt.

Tajinder: "Also discussed hydration of compounds, and why things dissolve and other compounds do not. I had learned about this last year, and understood the principle involved, but today was able to 'spit it out' as it were, and put it into words."

Keith: With some difficult concepts you seem to find it useful to keep returning to them, and rehearsing the ideas until you've fully mastered them.

Tajinder: "What I am not sure about: Raoult's Law" [then after a later session] "Started off with Raoult's law. Discussed mixtures of liquids. Very helpful made me think about the law, and it came back to bonding, which I enjoy actually. Made me think a lot today" [then after a later session] "Understand Raoult's Law fully now." [then after a later session] "Raoult's law, I think I fully understand." [then after a later session] "I do

understand Raoult's law fully." [then after a later session] "Very good revision over Hydrogen bonding and Raoult's law. Better and most helpful session."

...I was wrong, but worked it out in the end...

Keith: You seem to recognise that discovering you have misunderstood something is actually a *positive* step on a path to a deeper understanding.

Tajinder: "Discussed questions Keith put to me, about bonding, 'valent shell bonding'. Talked about PCl_5 [i.e. the molecular structure of a chemical compound]. Drew bonds present. Worked out that I was wrong to think that all valent electrons took place in bonding, but worked it out in the end. I liked the lesson today."

Keith: You know I'm not going to 'tell you the answers' when you go wrong, and I'm pleased you are prepared to accept this behaviour from a teacher and work through the ideas for yourself.

Tajinder: "Played card game. [Building up model atoms shell by shell to explain the idea of core charge.] Made me think about atoms and how they are made up. I enjoyed the tutorial today. ... I realised I still wasn't sure about 8+ - 8-, but worked it out in the end."

...I learn more in the tutorial because I am made to think how well I understand the work...

Keith: Indeed you seem to recognise the value of being 'interrogated' as a way of seeing just how robust your understanding is.

Tajinder: "Very difficult lesson. Very long, but worthwhile session. Didn't do to well today, I couldn't think properly. Understand Raoult's Law fully now. I find these sessions quite intense, very hard work, they rack my brains and I find out just how well I really do know my work."

Keith: You seem to appreciate that this helps you know that you have a 'deep' understanding that will allow you to apply your knowledge in new contexts.

Tajinder: "Today was quite an enjoyable tutorial [sic] after the first 20 minutes. Sometimes I wander whether I am learning anything during the tutorial but I realise I learn more in the tutorial because I am made to think *how* well I think I understand the work. Therefore if a problem is set to me I can hopefully think my way around it and not just get stuck."

...*now I'm a bit more confused than I was before...*

K: Right, I don't know how you found that. I don't know if you found all that rather confusing, or rather difficult?

T: No, it was all right.

K: I don't know if you saw what I was getting at at times, it was a bit mystifying?

T: No I could see what you was getting at. You were trying to understand how I understand chemical bonding, weren't you?

K: Mm. Did it make you think at all?

T: Yeah, it did, but I wasn't really clear about this, now I'm a bit more confused than I was before.

K: Mm, well maybe I'm asking you questions you just don't think to ask, you just take things for granted?

T: Yeah.

K: Yeah?

T: Maybe, yeah.

Keith: You don't seem entirely convinced about this. I guess sometimes you feel that you are just not making any progress?

Tajinder: "Most frustrating lesson. I was too unsure on many things, even things that I had sorted out last year like ionisation energies. Was very unsure about hybridisation and promotion."

Keith: Despite these set backs you are prepared to carry on with the sessions. I suppose you have sufficient confidence that in time you will get these things sorted?

Tajinder: "Bit slow to start off, and found this a bit frustrating. Got started and I explained hybridisation and promotion, and just needed a few things cleared up. I need to brush up on shapes of molecules, as I was a bit lost today. Multiple bonding is okay now. Group 5 chemistry is going well and I think I understand what is going on. Chemistry is going well."

...I do not like sorting the picture cards very much...

Keith: Most of our research sessions are in the form of conversations about ideas from your chemistry course, but sometimes I ask you to sort cards (Kelly's method of triads) instead. You seem to find that more difficult.

Tajinder: "Today was the first session of my second year of A levels and it is 3 weeks into the 1st term. Today I discussed picture cards in groups of 3, from which I characterise the pictures. I do not like the picture cards very much and find it difficult to find categories. It is helpful and makes me think. It was a difficult lesson today."

Keith: Okay, so you do think it can be helpful, but you don't really enjoy the experience. In that case I won't ask you to sort the cards again for a while, and we'll mostly concentrate on the interview sessions. [Some months later.] It is now some time since we tried using the method triads. How did you feel about it today?

Tajinder: "First tutorial [sic] with picture cards for a long time. Today's tutorial was not very interesting. I do not like it very much. I can't explain it, but it is very frustrating. Difficult lesson."

Keith: It seems that you find it more difficult to access your ideas in this way. As you find this technique frustrating, I should perhaps relax the rules a little, and next time we sort the cards you should free to develop the conversation without feeling constrained by the sorting protocol.

Tajinder: "Picture cards. The session was okay and it cleared up my theories of bonding. Pretty useful."

Keith: We seem to be developing an approach to sorting the triads that allows me to collect the data I want, without you feeling too uncomfortable. I think we should

consider the card sorting activity as part of a normal interview session, just as if I was asking about the pictures as I sometimes do in other interviews.

> Tajinder: "Picture cards. More useful than normal picture cards. Learned a lot as usual, and is going fine."

...a very long session, but time went very quickly...

> K: It doesn't give long does it, by the time you get started, it's just about, I suppose, an hour, I mean how much can you concentrate for? You know?
>
> T: Yeah. No actually, it goes all right, it's not bad. It goes quite quickly doesn't it? Last year it used to fly past, do you remember, we used to sit here for ages and ages.
>
> K: Yeah, but you've got more pressure on you at the moment though, haven't you?
>
> T: Yeah. I've got to go and do tonnes of homework now.

Keith: Sometimes we've sat here for a couple of hours, with me turning over and changing the tapes to get it all recorded, but it never seems that long to me. How about you, Tajinder?

> Tajinder: "Long session, about 2 hr 15 min, but it went very quickly."

Keith: As the exams get closer you must feel that your time is very precious?

> Tajinder: "Today was a very long session, but time went very quickly. It started off bit slow, and a bit frustrating but it was okay after that. It was very intense, but afterwards I felt very good. I learned a lot about molecular orbitals today. Most useful tuition I've had this year. I am very grateful to Keith for all his time and help for me. My chemistry revision is going quite well and I will be ready for my real exams in about 4 weeks."

...it's all worth it in the end...

> K: So I mean, that took, hour and a bit, yeah?
>
> T: yeah…it's worth it.

Keith: Obviously I set this process up because I saw the research as valuable to me as the teacher, but I hoped that you would feel some benefit from the process as well.

Tajinder: "The session today was quite good, I found it interesting and very helpful. The tutorials are helping me revise no end and I am very grateful to Keith. Hopefully after receiving a good grade, I shall thank Keith for his time and help."

Keith: There's no need to thank me. I've found the process fascinating. It has helped me as a teacher, and provided valuable data that I can write up to inform other teachers. I just hope you also feel you your commitment of time has been worthwhile,

Tajinder: "The tutorials are becoming more and intense and longer but it's all worth it in the end."

Monologue: the researcher's interpretation of the colearner's experience

Tajinder achieved the top grade in his chemistry examination, and went on to his preferred University course, and seemed to retain the view that '*it was all worth it in the end*'. Other colearners who contributed to the research also thought they benefited from their involvement (Taber, 2002), but Tajinder's commitment was by far the greatest. This came about in part because Tajinder seemed to especially value the sessions as opportunities to practice explaining his thinking and to learn about his own level of understanding.

As Tajinder felt he was able to learn something worthwhile from the sessions, and I thought that he was a rich source of research data, we mutually agreed to hold many more sessions than had originally been envisaged: over twenty sessions during his two year course. This element of negotiation is also evident in the decision to limit the frequency, and change the administration, of Kelly's triads - a technique being used alongside the interviews (Taber 1994c).

Keith had set out to conceptualise his 'subjects' as colearners - a term that he thought reflected his intention that both parties should learn from the process (Taber 1994b, 1997, 2002). Keith's 'ethical imperative' required that the colearners should feel their involvement was worth their commitment of time and their willingness to open their learning to close probing. Moje argues that "researchers should engage in research ... to make positive change in the lives of those who participate in research, change that the participants desire and articulate for themselves" (2000 p.

25). Frost suggests that in collaborative enquiry "we need to explore the dynamic of the collaboration[and] the degree to which aims are shared" (1995, p.314).

Keith felt that it was important that both parties to a research session should appreciate the purposes of the other (cf. Rudduck & Flutter, 2000) - and that the student's purpose should not simply be to please the teacher by acquiescing with the invitation to be involved! Keith's own perception of how learning takes place suggested that the interview process would potentially be very valuable for a learner, but he was not sure that the students would *recognise* this (cf. Cooper, 1993), or even accept that a teacher should be spending a session with them *asking rather than telling*.

At the end of an interview session Keith would administer a brief feedback sheet, and this suggested that the interviewees *did* find the sessions as useful opportunities to learn about their own progress, and generally thought they learnt something about science through the process (Taber, 2002). Keith was pleased that his colearners did seem to find the sessions genuinely useful. It seems that they had sufficient metacognitive knowledge, at least at a tacit level, to see learning as more than transmission of knowledge from the teacher.

In Tajinder's case this led to him volunteering to be interviewed regularly. He soon found completing the feedback form rather repetitive, and so an alternative form of feedback was negotiated: that he should complete a brief diary of his reflections on the interview sessions. It is that diary which acts as the source of much of the 'dialogue' presented above. It is clear from Tajinder's comments that he was able to make his metacognitive knowledge about his own learning explicit though the diary.

Tajinder's comments show that he thought that:

- understanding involved more than just recalling material from lessons;
- that thinking hard might be taxing, but is important in learning;
- that learning about scientific concepts is not a one-off action;
- knowing you are wrong is sometimes necessary to move your ideas on;
- testing understanding fully requires in-depth questioning;
- short-term confusion and frustration can be accepted as part of a long-term process;
- genuine engagement with course material can be intense, but ultimately worthwhile.

For Tajinder the overall experience of being interviewed for research was a positive one. This is despite the process involving periods of frustration and confusion. Clearly Tajinder was able to accept this because he had enough self-confidence not to be disillusioned by short-term set-backs, he had sufficiently developed metacognitive awareness to appreciate that 'deep' learning requires active mental processing, and he was strongly motivated by his ultimate goal of a university place on a course of his choice. It is not appropriate to assume that all college students would share these attributes, let alone - say - younger pupils of school age. All that the present paper demonstrates is that *it is possible* for some learners to experience even quite intense research sessions as ultimately worthwhile.

There are other examples of research in the literature which show that researchers are sometimes able to work with individual learners in similar depth (e.g. Harrison and Treagust, 2000), and even that such research subjects display mature levels of metacognition (e.g. Petri & Niedderer, 1998), but we are not aware of another detailed case study of individual learning where the subject's own feelings about the process have been elicited to this extent.

Epilogue: how authentic is Tajinder's voice in the dialogue?.

The role and status of the research 'subject' must be an ethical concern for any researcher making demands upon learners, especially where there is a clear imbalance of power in favour of the researcher (Frost, 1995). Day argues that "not only must the design and processes of research and development be the result of joint planning and action, but that the written account(s) and its dissemination must reflect this." (1995, p.367).

This paper claims to be cowritten and to give voice to the research subject. However, it is clear that - just as in the reports of Tajinder's learning - this report of Tajinder's feelings has been *compiled* by the researcher. The claim for this paper to represent Tajinder's authentic voice must therefore be seen to be open to dispute (cf. Moje, 2000; Zajano & Edelsberg, 1993).

The first author has taken care to represent his colearner fairly. There has been minimal editing of Tajinder's words in his diary. The full text includes Tajinder's notes on topics he was struggling with in his revision, and these listings have been omitted, but I have included in the 'dialogue' all of Tajinder's comments about the research sessions.

In editing Tajinder's diary I have removed his comments from their original temporal order, and rearranged them thematically. I have then interspersed both extracts of genuine conversation from interviews, and new text to construct the 'dialogue' and so provide a narrative for the reader. Clearly this is both an interpretative and creative process, and one which could potentially obscure or distort Tajinder's intended meanings.

It has certainly not been my purpose to misrepresent Tajinder: indeed quite the opposite. But Tajinder has now moved on from being a college student: he does not occupy the time, space or stage of conceptual development that he did when he first recorded his thoughts, and he does not write about educational matters. As his partner, his colearner, in the research enterprise, and someone who has had reason to reflect upon this process of data collection at some length, I consider my attempt to re-construct his thoughts into a coherent narrative is both appropriate and informative. I am certainly not disinterested or neutral about the case: rather I am connected and involved, as (then) his teacher and colearner, and I am interested in publishing this account as (now) a teacher-educator and researcher. In Kvale's terms I hold the "knowledge of the subject matter, [and] expertise in the field studied" needed to present valid interpretations." (1996, p.182).

The reader must however bear in mind the caveats presented here, and make a judgement about the extent to which I am qualified and able to act as Tajinder's editor: to reconstruct an authentic account of his experience of being a 'subject' in the research process. Assuming the reader grants me that privilege, then I feel Tajinder can tell us a lot.

The research process, like any educational process, has inherent power relationships which are not easily undermined. However, Tajinder shows us that when a researcher has an explicit ethical imperative it is sometimes possible to involve learners in intense and demanding research activities as part of a genuine shared enquiry. In this case the teacher-researcher and colearner clearly had somewhat different objectives: but these were explicit, and the needs of both were explored and shared in the enquiry.

There are many questions left unanswered. To what extent is Tajinder unusual? Would many learners have the self-confidence to experience a process of confusion and frustration in such a positive light? To what extent did Tajinder demonstrate unusual levels of metacognitive awareness? Indeed, did Tajinder's relatively sophisticated view of learning in part develop from being involved in this type of enquiry process? And, if so, was the explicit stance taken (to see 'subjects' as

colearners, to ask them about their experiences, to negotiates aspects of the process with them) a contributing factor?

As always, case studies lead to uncertainties about generalisation, and research leads to more questions for research. I am grateful to my colearner, and coauthor, for the gifts of time, and dialogue, and of those further uncertainties and questions.

References:

APA (2001) *Publication Manual* of the American Psychological Association (5th Edition) Washington: APA.

Cooper, P. W. (1993) Field relations and the problem of authenticity in researching participants' perceptions of teaching and learning in classrooms, *British Educational Research Journal*, 19 (4), pp.323-338

Day, C. W. (1995) Qualitative research, professional development and the role of teacher educators: fitness for purpose, *British Educational Research Journal*, 21 (3), pp.357-369

Frost, D. (1995) Integrating systematic enquiry into everyday professional practice: towards some principles of procedure, *British Educational Research Journal* 21 (3), pp.307-321.

Harrison, A. G. & Treagust, D. F. (2000) Learning about atoms, molecules, and chemical bonds: a case study of multiple-model use in grade 11 chemistry, *Science Education*, 84, pp.352-381.

Kvale, S. (1996) InterViews: An introduction to qualitative research interviewing, Thousand Oaks, California: SAGE Publications.

Limerick, B., Burgess-Limerick, T. & Grace, M. (1996) The politics of interviewing: power relations and accepting the gift, *International Journal of Qualitative Studies in Education*, 9 (4), pp.449-460.

Moje, E. B. (2000) Changing our minds, changing our bodies: power as embodied in research relations, *International Journal of Qualitative Studies in Education*, 13 (1) pp.25-42.

Petri, J. & Niedderer, H. (1998) A learning pathway in high-school level quantum atomic physics, *International Journal of Science Education*, 20 (9), pp.1075-1088.

Rudduck, J. & Flutter, J. (2000) Pupil participation and pupil perspective: 'carving a new order of experience', *Cambridge Journal of Education*, 30 (1), pp.75-89

Taber, K. S. (1994a) Misunderstanding the ionic bond, *Education in Chemistry*, 31 (4), pp.100-103.

Taber, K. S., (1994b) The teacher-researcher's duty: accounting for ourselves to our co-learners, in Laidlaw, M., Lomax, P. & Whitehead, J. (editors) (1994) *Proceedings of Accounting for Ourselves, World Congress 3: Action Learning, Action Research and Process Management*, Bath: University of Bath, pp.230-233.

Taber, K. S. (1994c) Can Kelly's triads be used to elicit aspects of chemistry students' conceptual frameworks?, paper presented at British Educational Research Association Annual Conference, September 1994, University of Oxford - available via Educatio*n-line*, at http://www.leeds.ac.uk/educol/

Taber, K. S. (1995) Development of Student Understanding: A Case Study of Stability and Lability in Cognitive Structure, *Research in Science & Technological Education*, 13 (1), pp.87-97.

Taber, K. S. (1997) Understanding Chemical Bonding - the development of A level students' understanding of the concept of chemical bonding, Ph.D. thesis, University of Surrey.

Taber, K. S. (1998) An alternative conceptual framework from chemistry education, *International Journal of Science Education*, 20 (5), pp.597-608.

Taber, K. S. (1999) An explanatory model for conceptual development during A-level chemistry, a paper presented at the Roehampton/Surrey symposium *Teaching, learning and relevance in classroom science* at the annual meeting of the *British Educational Research Association*, September 1999, University of Sussex - available via Educatio*n-line*, at http://www.leeds.ac.uk/educol/

Taber, K. S. (2000a) Case studies and generalisability - grounded theory and research in science education, *International Journal of Science Education*, 22 (5), pp.469-487.

Taber, K. S. (2000b) Multiple frameworks?: Evidence of manifold conceptions in individual cognitive structure, *International Journal of Science Education*, 22 (4), pp.399-417.

Taber, K. S. (2001) Shifting sands: a case study of conceptual development as competition between alternative conceptions, *International Journal of Science Education*, 23 (7), 731-753

Taber, K. S. (2002) "Intense, but it's all worth it in the end": the colearner's experience of the research process, *British Educational Research Journal*, 28 (3), pp.435-457.

Taber, K. S. and Watts, M. (1997) Constructivism and concept learning in chemistry - perspectives from a case study, *Research in Education*, 58, November 1997, pp.10-20.

Zajano, N. C. & Edelsberg, C. M. (1993) Living and writing the researcher-researched relationship, *International Journal of Qualitative Studies in Education*, 6 (2), pp.143-157.

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