Scaffolded autoethnography: a method for examining practice-to-research

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***Abstract**: Teachers often perceive educational research as confusing and can be disenfranchised by the research process. We propose scaffolded authethnography as a method to support principled examination of authentic practice. The approach is appealing because it is motivated by the teacher's own day-to-day practice in a research context. Our demonstration of this method uses an analytical autoethnographic approach coupled with a data capture tool that documents the pedagogic content knowledge of a practicing teacher. We include a short case-study description where the method was used in the context of research in the area of threshold concept identification.*

Introduction

Disciplinary-specific education research has the peculiar feature that its methods of investigation are not linked to the methods of the discipline: engineering education research does not use the methodologies of engineering research. This means that there is no shared epistemology between researchers in engineering and researchers in engineering education, and no agreement on how to share knowledge or how to demonstrate that something is "true". What *is* shared is a "vulgar competence" – both types of researcher are competent in relation to the discipline under scrutiny and have an understanding of the investigated phenomena and the site of the research (Garfinkel 1984).

The separation of educational research from educational practice is a known problem that can impede education researchers. Writing about developments in higher education Lee Shulman noted "The field of teaching in higher education has been limited by the features of a generic or technical view of teaching" (Shulman 1999, p.x). He identified "the study of subject-matter and its interactions with pedagogy" as the missing paradigm in research on teaching (ibid., p.ix). The accent on the relationship is important - the focus is neither on the subject-matter nor its delivery, but the point at which they come together.

Meyer 2010 has described the challenge that the voluminous research literature on generic teaching and learning presents for practitioners. "There is a big gap between reading about, being taught about, reflecting on, and discussing…how students learn in general and how they learn in the subject or discipline" and this makes it difficult to "unpack and demystify" into a form that is "accessible to all university teachers" (Meyer 2010, p.196). Offering support for Meyer's view Cousin notes that the challenge he identifies is always an uphill struggle because "getting academics to underpin their reflections on their practice using educational theory" often reduces them to the status of "informed amateurs in another discipline" (Cousin 2010).

We present an approach to address these problems using an analytic autoethnographic research method scaffolded within a structured framework – what we call *scaffolded autoethnography*. It is the power of situation that makes this research method immediately appealing – the fact that the investigation is motivated by teachers' own work and intimately related to their own day-to-day practice. The 'site' of the research is close to the work of pedagogues, and their students, and the research is inextricably linked to the issues that make sense in their own discipline.

In the next section we describe a framework developed by Loughran et al. to capture a particular aspect of teacher's practice – pedagogic content knowledge (PCK), which we used as our scaffold. This is followed by a description of analytic autoethnographic and the identification of some methodological issues associated with it. We then describe how the scaffolded autoethnography method resolves issues associated with the autoethnographic approach. Finally, we provide a short description of a case study example in which we used the approach in an educational research context.

Framework for Documenting Educator Expertise

Shulman described pedagogic content knowledge (PCK) as the knowledge an expert teacher has that allows them to flexibly transform their subject-matter knowledge into forms accessible to their students (Shulman 1986). We take a simple approach to PCK; we hold it to be the property of an individual. For example, a teacher with low PCK knows one way to teach recursion, and applies it uniformly. A teacher with high PCK, may know a dozen or more ways to teach recursion, each exquisitely suited to the needs of students at different developmental stages, with particular background knowledge, or in certain contexts. The benefits of PCK are highlighted by Perkins when he notes “Seasoned teachers know what troubles are likely and draw on active, social, and creative learning to address them” (Perkins 2006, p.36). Bond-Robinson uses the term *transforming explanation* to describe the type of explanation a teacher with high PCK uses in their teaching (Bond-Robinson 2005).

Transformation is not restatement and to engage in an explanatory process teachers must arrange and present their knowledge of the subject-matter in a form suitable for their students. Thus PCK is a nuanced attribute: the different teaching approaches are elicited by need, by the specifics of student and situation, they are not catalogued and learned by rote. Indeed, they may be hard to catalogue, and a characteristic of PCK is in the very recognition of need and then in making an apt response to the unpredictable learning difficulties that spontaneously arise.

Good teachers grow and develop and discover new ways to approach subject matter, their PCK increases over time. But PCK does not exist separately from the teacher that possesses it: you cannot take one person's PCK and swap it with someone else's. Although equally skilled, an educator with a background in object orientation does not teach recursion the same way as someone with a background in functional programming, they have different ways of packaging and presenting knowledge and a different repertoire of approaches. Building on this belief, we seek methods that privilege individual knowledge, in contrast to other researchers who believe that PCK is either an abstract concept that has properties separate from its application (Hubwieser et. al. 2013) or that it may be constructed as a collage from bits and pieces out of many individuals' heads (Zwaneveldt et al 2015 *in press*).

Loughran and his colleagues developed a framework to document PCK. The framework grew out of attempts at sharing authentic teaching expertise and skill through brief anecdotes and stories of in-class experiences, reflecting McLean's observation that “the proper place to study elephants is the jungle, not the zoo” (McLean 1973). Through conversations and shared observations Loughran's group developed a representation that captures important aspects of instantiated practice that expose PCK. The representation provides access and support for the two foundational components of PCK (i.e. content knowledge and general pedagogic knowledge) with the intention of bringing them to the forefront of the teachers' thinking and thereby allowing them to be better understood (Loughran et al. 2006). As Shulman explained “Critical reflection on one's practice and understanding leads to higher-order thinking in the form of a capacity to exercise judgment in the face of uncertainty and to create designs in the presence of constraints and unpredictability” (Shulman 2002, p. 38).

The representation is called a CORE, a mnemonic for Content Representation using the first two letters of the words, and written as CoRe. (Loughran et al. 2006) have provided several examples of CoRes developed for topics in science. A CoRe is a two-dimensional grid. Along the vertical axis of the grid is listed a series of questions or prompts, that are intended to provoke consideration of a particular concept and motivate elicitation of a teacher's pedagogic knowledge in relation to the concept. Along the horizontal axis the teacher captures their content knowledge of the concept by listing what they consider to be the "big ideas" associated with this concept. The number of ideas is not restricted and individual teachers can include as many as they wish. At the intersection of each row and column the teacher makes an entry documenting their response to the row prompt for the big-idea in the column. A sample CoRe is shown in the case study below.

The prompts in the first column oblige the teacher to document their view of how and why each big-idea can and should be taught. The teacher's responses to the prompts elicit the basis on which they make a variety of decisions about how they present the idea to students. In addition, it provides a useful insight into how the teacher has come to appreciate why a particular concept proves difficult for students to grasp. What the teacher records is what has evolved as their (current) best strategy for dealing with this difficulty. Thus, the entries made by the teacher can be taken to represent what they consider exemplary or best practice for teaching this idea.

Loughran and his collaborators describe their formulation as a "powerful, accessible and useful representation" of PCK (Loughran et al. 2006, p.26). Several benefits accrue from the CoRe representation. The grid format is simple to use, particularly in soft-copy format. The intersecting rows and columns can act as a bridge between theoretical and practical aspects of teaching but the focus is always on bringing the teacher's expert knowledge to the fore. Populating the grid with entries obliges the teacher to document, explore and analyse their own practice and makes what is normally implicit, private and individual for the them explicit, clear and meaningful for both themselves and others. This reduces the influence and dependence on generic descriptors of good pedagogy and provides a powerful, more sophisticated approach to unpacking the expertise associated with teaching a particular concept.

Analytic Autoethnography

Autoethnography is a methodology borrowed from anthropology that utilizes the autobiographic materials of the researcher as primary data. It combines three aspects (1) the content orientation which is focussed on the self ("auto"), (2) the interpretative orientation with its emphasis on the cultural ("ethno"), and (3) the methodological orientation that examines autobiographical data through a critical, analytical lens as part of the research process ("graphy"). Thus autoethnography "combines cultural analysis and interpretation with narrative details" but the stories are "reflected upon, analyzed, and interpreted within their broader sociocultural context" (Chang 2008, p46).

Autoethnography situates the researcher in a critical relationship with others in the same cultural situation (for example, the teaching of engineering in tertiary education). This ethnographic aspect distinguishes autoethnography from other narrative-oriented writings such as autobiography, memoir, or journal and has established it as a "rigorous ethnographic, broadly qualitative research method" (Chang 2008, p57), and positioned it as a frequently used method in educational enquiry (Hayler 2007; Granger 2012).

Anderson describes how evocative autoethnography, the traditional approach to autoethnographic research, is based on a free-form style that requires considerable narrative and expressive skills and seeks to create an empathetic or emotional resonance with the reader. This subjectivity can lead to distrust of the approach, particularly when its use is suggested in the context of scientific or technological disciplines. In contrast, Anderson advocates a more regularised approach that emphasises a formalised rhetoric and method. Analytic ethnographers are not content with solely accomplishing the representational task of capturing "what is going on" in an individual life or social environment but are directed towards theoretical development, refinement and extension (Anderson 2006, p387).

Whilst autoethnography permits distinguished access to the development and expression of a teacher's practice there are some points of potential difficulty which may be broadly categorised under the headings – process, data and analysis. (Chang 2008, p54) has enumerated the difficulties as follows

1. excessive focus on self in isolation from others
2. overemphasis on narration rather than analysis and cultural interpretation
3. exclusive reliance on personal memory and recalling as a data source
4. negligence of ethical standards regarding others in self-narratives
5. inappropriate application of the label "autoethnography"

Scaffolded Autoethnography

Coupling the analytic autoethnographic methodology with the CoRe structure creates a hybrid approach we describe as *scaffolded autoethnography*. The approach provides two significant benefits. The first accrues from the explicit documentation of expert reflective practice and its capture using the simple structure of a scaffold. The second accrues from the inherent properties of the CoRe which neutralise some of the five potential problems listed above.

Using the CoRe not only allows the research to remain faithful to the term "autoethnography," addressing point five, it also reinforces it by the adoption of Anderson's "analytic autoethnography" approach. The CoRe framework captures "what is going on" and the accompanying narrative adds value and quality by providing a broader generalisation. This embeds the analysis in a coherent disciplinary framework.

Autoethnography can be criticised for its singular focus and the conclusions drawn from that one perspective (points one and two), for whilst it is *de facto* a valid interpretation, it may not be reliable or replicated. The CoRe analysis is not limited to a single person (i.e. self) because people do not accumulate their experiences in a social vacuum. It is informed by the outcomes of personal reflective practice but also by the individual's awareness and knowledge of the reflective practice of others, acquired through working with colleagues (sometimes across various institutions), as well as knowledge of the curricular and pedagogic literature, and from personal interaction and exchange. The CoRe is reflective of, and draws on, the individual's immersion in the culture of the discipline and its pedagogy, in marked contrast to an isolationist perspective.

The CoRe documents a conceptual framework and exposes the cohesion over what were previously viewed as disparate concepts. It is populated through an analytical process that obliges the person filling it in to reflect on, question and justify their choice of "big ideas" and the pedagogic strategies that can be applied to realise the transformative outcome, in a process similar to Schön's "reflection on action". Thus completing a CoRe is an act of reasoned analysis, not memory recall (addressing point three).

Using a scaffold, such as the CoRe form, addresses point four. The framework is "ethics neutral" because, although it draws on others, and the work of others – students, colleagues, text-book authors – its analytic form means they are not involved (or implicated) as participants, as is more common in other autoethnographic forms, such as oral histories or emic accounts of native ethnography.

Autoethnography is not meant to produce "undebatable conclusions" (Anderson 2006, p388) but it does attempt to ground the connections between the insider's perspective provided by the researcher's presentation of the research and the theoretical understandings of broader phenomena. The user of autoethnography is engaged in a process of reflective practice that includes awareness of the discursive milieu and ongoing critical consciousness and self-examination. None of these things begin or end when one adopts or discards the title of researcher. The autoethnographic approach scaffolded with a CoRE enables the researcher to effectively contextualise their practice, as it emphasises separation of their representation and interpretation roles, to manage the research work effectively and to ensure the integrity of the process, the data and the analysis.

Threshold Concepts

In education research the idea of "threshold concepts" has been identified as one of the top-ten new educational terms, theories, and practices that have the potential to provoke major shifts in educational practice and transform tertiary education (Sharples et al. 2014). A little over a decade ago Meyer and Land described how learners experience threshold events in their learning when they encounter troublesome knowledge that impedes their progress. The 'stuck' space is viewed as a threshold they must cross. The threshold is crossed when the learner acquires the concept that resolves the learning difficulty and removes the barrier to progress. Concepts that have this effect are categorised as threshold concepts (TC) and are characterised by their ability to integrate other concepts that previously had been viewed by the learner as strangers to each other. The integrative effect transforms the learner's view of the subject matter and opens up new learning possibilities (Meyer and Land 2005).

For example, (Knight et al 2014) have nominated *critical flow* as a threshold concept in civil engineering courses on open catchment hydraulics. Critical flow is troublesome because it cannot be observed by watching water flow; it integrates different flow types (e.g. uniform, gradually varied, rapidly varied); and it transforms "how solutions are obtained and interpreted" (ibid. p132). The ability of students to think about and analyse flow profiles hinges on their understanding of critical flow because without it they would be "unable to predict the flow of water within engineered systems" (ibid. p139).

The threshold concepts idea has been enthusiastically embraced by pedagogues because it emphasises subject expertise (Cousin 2008). Indeed the significance of threshold concepts is that they attempt to locate troublesome aspects of disciplinary knowledge and not teaching knowledge (Land, Meyer et al. 2008, p.xi) and they require an academic to go "more deeply into her own [discipline] for the purposes of formulating the best ways of teaching and learning it" (Cousin 2010).

To-date threshold concept researchers have found it difficult to devise a method for identifying threshold concepts and those that have been developed have yielded tentative proposals only. In her review of the different approaches Baradell notes their varied nature which includes informal, semi-structured, and phenomenographic style interviews; surveys and questionnaires; examination paper reviews and short answer problems; as well as the observation of classroom behaviour (Barradell 2013).

The resonance between pedagogic content knowledge and threshold concepts is striking. Both are located at the site of troublesome learning experiences. Both involve the transformation of individual, disparate concepts into a uniform whole. Both are committed to deep learning that facilitates the development of discipline expertise, discipline immersion and identity (i.e. thinking and acting like an engineer or computer scientist). We hypostasised that threshold concepts are likely to be the site of considerable PCK as expert educators must necessarily develop a repertoire of approaches to help students overcome the conceptual hurdles they find the most difficult. Rather than scrying across the discipline, we turned our search around and looked for evidence of threshold concepts within the autoethnographic situation of a single teacher's expert knowledge (Shinners-Kennedy 2012; Shinners-Kennedy and Fincher 2013).

The exposition began with a tabular CoRe to capture and display the first author's PCK with regard to the concept of "state," which we nominated as a threshold concept in computing. A partially complete version of the CoRe is shown below. It enumerates a collection of concepts and documents how their integrative effects can transform explanations and resolve troublesome aspects of the subject matter encountered by students.

The aspects of state that are embodied in the chosen “big ideas” range from the very basic concepts of programming to the most powerful and most intellectually demanding. Each concept made explicit within the CoRE structure is situated in the context of the first author’s teaching practice, annotated with references to the extensive literature that documents the history of difficulties novice programmers experience with the concept of state. In this way the situated representation demonstrates the wider currency of the material and shows that whilst the chosen concepts represent one individual’s perspective, they are not idiosyncratic.

The CoRe provides a lens through which to identify the integration that characterises a threshold concept. In this case it displays how the concept of state integrates programming concepts which are often viewed by teachers as disparate. The coherence embodied in the CoRe exposes what is sometimes hidden in plain sight from programming educators and practitioners – state management is the essence of programming. Every technique and tool in the programmer’s repertoire is concerned with supporting versatile and efficient management of the state space. Throughout the history of software design and development, all of the techniques and insights that have had a significant influence on the discipline (e.g. structured programming, object orientation, information hiding) have had state as their focus.

Whilst the CoRe is inherently autoethnographic and privileges one individual’s knowledge the act of capturing the accumulated wisdom embedded in the PCK of an experienced teacher provides a basis for discussion. It facilitates researchers working together in an analytic way to reach common ground and to provide a rationale and technical justification for a proposed threshold concept.

Threshold concepts and pedagogic content knowledge represent a synergy of ideas because they both have deep understanding of content knowledge at their centre. Both are student focused but not student centred. Both rely on the expertise of reflective pedagogues but are distinguishable by the sharpness of the focus in their respective lenses. Pedagogic content knowledge has a wide view whereas threshold concepts zoom in on content knowledge that derails student learning. We suggest the two ideas are linked and are mutually supportive.

Conclusions

Scaffolded autoethnography as a research method provides several benefits. Firstly the framework (the scaffold) guarantees that the results can be interpreted outside of the context in which they were gathered, whilst respecting the warrant of authenticity. By using a common scaffold results may be compared to (or combined with) the work of others. Secondly the results may be recognised by anyone who teaches the subject matter, so although they are not produced by disciplinary (e.g. engineering) methods they may be apprehended by subject experts who share vulgar competence with the autoethnographic researcher. Using the scaffolded autoethnographic approach allows an individual teacher turn their pedagogic practice into an educational research artefact that contributes to the wider literature, in this case the novice programmer research milieu.

Threshold concepts can be linked with pedagogic content knowledge. Both rely on the expertise of reflective pedagogues and are situated at the site of student learning difficulties in their encounters with troublesome knowledge. Both have deep understanding of discipline content knowledge at their centre. Thus, the scaffolded autoethnogrphy method we propose here may also be an effective way to identify candidate threshold concepts and expose them for wider consideration and debate.

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Year Level for which this CoRe is designed ***Year 1 Introductory Programming***	**State Space**	**Notional Machine**	**Variables**	**Methods and Parameter Passing**	**Design/Decomposition**
What you intend the <u>students</u> to learn about this idea.	What state space is and that it is vast, even for small problems.	ONLY two operations (inspect and alter) a computer can perform.	Variables are used to record state and are central to all programming environments.	The state space is too large to attempt to comprehend as a single unit and needs to be broken down into more manageable units. This obliges us to develop information sharing facilities so that the units can interact.	Breaking problems down is a fundamental feature of solving problems. Programming is not about writing a 10,000 line program but about writing 1,000 10 line programs.
Why is it important for students to know this.	The vastness is the source of difficulty.	ALL programs are collections of inspect and alter operations clothe in 'sophisticated' programming constructs which provide a more abstract implementation.	Without variables we cannot flexibly utilise and control the inspect and alter operations.	Modern design techniques attempt to partition the state space into logically coherent units or objects. Methods are a stepping stone to this.	Every "real" and example program the students encounter will be structured as a series of relatively small, cooperating methods which are the result of design decisions that attempt to structure the solution for reliability and comprehension.
What else <u>you</u> know about this idea (that you do not intend students to know yet).	Programming expertise = intelligent state space management.	This notional machine is called a Turing Machine and is the basis for the theory of computation.	Variables can record very trivial states or very sophisticated states and this may give rise to different notations being used to manipulate them even though the operations are the same (i.e. inspect and alter).	Methods and sharing information between them will dominate the development of the students programming expertise.	Dijkstra on importance of structure and knowing what it is (glass box equivalent). Regardless of the paradigm used system design is based on the partitioning of state into a "useful structure" (EWD).
Difficulties/limitations connected with teaching this idea.	This is the student's first formal introduction to abstraction.	This idea is deceptively simple and therefore NOT perceived as important by students. This view may invoke "defended" learning in the form of unbelievability.	Variables are discrete NOT continuous values and must be explicitly manipulated. Initialisation is a crucial operation	The discipline of computing has entrenched but confusing and inappropriate language for describing this concept.	Partitioning problems is difficult and it requires a lot of practice. The strategies used for partitioning them are all based on state space although not always obviously so.
Knowledge about the students' thinking which influences your teaching of this idea.	It is the absence of students thinking about this item that influences my teaching of it.	Popular view that "cool" computing stuff is derived from complexity and sophistication when in fact it is from simplicity.	Students often think the variables "act" independently and "behave" as the students expect them to, especially if they have meaningful names.	Students frequently experience the issues associated with this concept (e.g. on their Facebook pages) but they remain part of their inert knowledge.	Students will tend to focus on the processing required to solve a problem and this can lead to decompositions that are unworkable. Early and often examples of state-based decomposition is a "start as you mean to continue" approach.

Year Level for which this CoRe is designed ***Year 1 Introductory Programming***	**State Space**	**Notional Machine**	**Variables**	**Methods and Parameter Passing**	**Design/Decomposition**
Other factors that influence your teaching of this idea.	Introduce the idea of problem boundaries and conscious decisions to bound problems.	This idea is pervasive and completely independent of the programming paradigm used to teach novices.	Variables tend to have "roles" and fall into idiomatic categories which can assist acquisition of the idea of a variable.	This concept plays a pivotal role in the development of design knowledge. Most follow-on courses will depend on this concept.	The use of objects is notoriously problematic for novices. We need to be cognisant of these difficulties.
Teaching procedures (and particular reasons for using these to engage with this idea).	Invite students to determine the state space for imperial weights (i.e. ounces, pounds, stones, etc. and distances (inches, feet, yards, furlongs, miles, etc.); for time and dates; possible phone numbers used by telecommunication providers in a particular country and globally;	Using examples from domains that the students are familiar with to explore the inspect/alter idea (e.g. mobile phone contacts list, spreadsheet creation).	Introduce the "roles" applicable to variables and develop the students understanding of their importance. See RoV papers		
Specific ways of ascertaining students' understanding or confusion around this idea (include likely range of responses).	Ask questions like "What are the consequences of two mobile phone top-up machines issuing the same number?"; "How could it be avoided?"; or invite students to explain "How the GPS works" or "Why and how they restrict access to their Facebook page."	Use everyday examples with "obvious" inspect/alter behaviour. Get students to trace short programs. Ask students to explain the purpose and benefits of slow-motion replays. Mavaddat's maze machines and Light Bot "game".	See RoV papers		