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Renata Phelps
Southern Cross University

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The Potential of Reflective Journals in Studying Complexity 'In Action'

RENATA PHELPS
Southern Cross University (Australia)

As educators embrace theories of complexity to inform their teaching and research practice, theoretically relevant methods will be required to appropriately conduct and study complexity-based approaches to education. Action research has been identified as offering significant potential for studying complexity, acting as a form of 'real life modeling' for learning and teaching. In this paper it is argued that reflection, a key aspect of action research, can be a productive method for both studying and working with complexity in educational contexts. Reflective journals, more specifically, provide scope not only for gathering research data but also for promoting learning and change. As a teaching approach, reflective journals can reduce the impact of external control while providing opportunities to promote and document instability and disequilibrium. Reflective journals allow for documentation of emergence and bifurcation and embrace participants' involvement in interpretation of data in inherently non-linear ways. Reflective journals assist to build up an holistic picture of the interplay between individuals' histories and their current and emergent 'state', thus providing insight into 'sensitivity to initial conditions'. This paper illustrates these theoretical ideas through a case study derived from a course in information and communication technology (ICT) for practicing teachers.

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Introduction

Complexity provides many theories and ideas to enrich our understandings and practices at all levels of contemporary education. However, for researchers and practitioners alike there is a need to identify research, teaching and assessment methods that are relevant, practical and theoretically appropriate to our study of complexity in education. This paper draws on ideas proposed in an earlier publication (Phelps & Hase, 2002), in which we argued that action research not only provides a theoretically compatible approach to the study of complexity in education. but is also a methodology that supports complexity-based teaching practice. Building on these ideas, this paper discusses the potential of reflection, and reflective journals in particular, in providing not only a valid research methodology, but also a learning, teaching and assessment tool that is consistent with complexity-based education.

This paper will firstly provide a theoretical exploration of the congruence between reflective journaling and complexity theories before presenting a case study of one course where reflection played a central role in the teaching and learning process. The paper assumes that the reader is broadly aware of the theoretical underpinnings of complexity (for instance, Waldrop, 1992; Progogine & Stengers, 1984) and in particular its application in the social sciences and education (as presented, for instance, in the writing of Doll, 1989; Eve, Horsfall & Lee, 1997; Fleener, 2002; Stacey, 2001). While the scope of this paper does not allow a detailed exploration of these theories, per se, it will instead focus on their manifestation and application within reflective-based approaches to education.

Theoretical Perspectives on Reflection and Complexity

Reflection might be defined as a mental process in which one thinks about things by going back over them. Reflectivity involves mental reaction to perceived issues and inconsistencies and a willingness to challenge personally held values, beliefs and assumptions. Since the early work of Schön (1983), reflection has been embraced as an important component of adult and professional education and it plays a central role in action learning and action research (Carr & Kemmis, 1990; Kemmis, 1985; Kemmis & McTaggart, 1988) and the related approach of experiential learning (Boud, 1989; Kolb, 1984), whereby knowledge is created by the transformation of experience through observation and reflection. Reflection can take many forms in teaching and learning. It can be an individual or group activity; it can be formative, cumulative or summative; verbal or written; shared or introspective; assessed or non-assessed.

While a number of complexity-based educationalists refer to reflection (Bloom, 2001; Gough, 1999; Stacey, Griffin & Shaw, 2000), few have yet explored in depth its potential as a method for both studying and working with complexity in educational contexts. Yet reflection provides scope not only for gathering research data but also for fostering and assessing learning in ways that are congruent with complexity theories. In this paper I focus particularly on the use of *written reflective journals* as both a teaching, learning and assessment approach *and* a medium for recording research data. While I do not argue that written journals are the most ideal reflective approach, they have proved to be a practical, workable and theoretically sound approach in my own research and teaching context, as the later case study will illustrate.

Reflective Journals as an Approach to Learning and Teaching

As educators we are all too aware that students' learning within formal, institutionalised contexts is driven predominantly by the assessment tasks we set. In utilising traditional assessment strategies such as essays, exams, research reports and so on, we are frequently simplifying and compartmentalising students' learning. Outside educational contexts learning occurs in quite different ways. It is generally non-linear, unstructured and experiential in nature. In these contexts assessment of learning is not a separate activity, but rather happens through constant reflection on experience and self-evaluation where we become aware of gaps in our knowledge and/or the need to pursue new information or different learning goals. Reflective journals offer an approach not just to assessment but to teaching and learning within institutional contexts. Such an approach is not only more authentic, but is more consistent with complexity's understandings of learning and teaching. The use of reflective journals can represent a conceptualisation of assessment, not as separate from the learning process, but rather as a highly individualised expression of learning that is shaped by the experiences of individuals themselves. No aspect of learning that is important for the individual need be excluded from the journal.

Complexity provides a perspective on learning based on non-linearity of thought and on variation as a source *and* outcome of thinking (Bloom, 1998; 2000). Reflection is an inherently non-linear approach to learning, and reflective journals embrace non-linearity, enabling intermingled documentation of ideas and experiences from the past, the present and the imagined future. Journals need not represent a logical, sequential argument but can evolve and grow from experience, interactions and complex thought processes. In this sense they can be seen to embrace concepts of learning as emergent, a natural and evolutionary process that is neither imposed nor ran-

dom (Doll, 1997-8). There is no notion of 'right' or 'wrong' in the experiences documented by learners and variation, individualisation and localised experience and knowledge are embraced. Journals are a form of personal narrative and, as such, provide potential to present one's own adaptation to the environment and the emergent nature of action and knowledge.

Notions of feedback and feedforward, which are discussed in complexity, provide justification for the importance of history and tradition (Turner, 1997) and provide further argument for the value of reflective learning experiences. Journaling can stimulate individual students to build up an holistic picture of the interplay of their past experiences and background with their current and emerging 'state', and in this way to help them to understand the manifestation of, in complexity terms, 'sensitivity to initial conditions'—the notion that the long term trajectory of a system is highly sensitive to its starting point and that long term behaviour of a system is determined as much by small chance changes as by deterministic laws (Stacey, Griffin & Shaw, 2000). No-one knows the complex interplay of factors that impact on an individual, or the significance of any one factor, greater than the individuals themselves. This is not to assume for a moment that the individual learner is fully aware of all these factors, but rather that they are in a better position to understand them than anyone else. Through guided reflection individuals can be prompted to reflect at a deeper level on these factors, assisting them to come to more awakened awareness of the role of history and initial conditions on their current learning context.

Complexity-based approaches to teaching and learning emphasise meaning rather than decontextalised content and a sense of ownership over what is learnt (Bloom, 2000). The open nature of journals reduces 'control' over either the experiences involved in learning or the contributing factors individuals draw from. Reflective learning does not assume that superior ideas will supercede inferior ones (as consistent with Sumara & Davis, 1997a) as learners' cognitive processes while journaling are more analogous to an experiment—where ideas can be tried, held up to scrutiny and 're'-flection. There is no assumption that students will arrive at one 'destination' within this teaching framework.

Complexity provides us with alternative conceptions of our role as teachers. As highlighted by Davis and Sumara (1997; Sumara & Davis, 1997a), teachers can present occasions that are rich with learning possibilities in which they might participate with their students in the unfolding of understandings, however, they cannot prescribe what will be learnt. Journals provide potential for teachers to embrace the emergent process of learning. They allow students to document what impacts most significantly on *them* as learners, recording interactions with others and the meanings that they personally construct from these interactions. These may or may not be

the stimuli that educators might expect to have greatest impact since 'although we may be able to predict that certain types of events or ideas may arise, we cannot predict the specific content or outcome' (Bloom, 2001, p. 23). For instance, vital learning might arise from experiences that are not directly or even indirectly related to the course or topic itself. A reflective journal allows such experiences to be acknowledged and validated as important contributors to learning.

From the perspective of complexity, participating agents play an active role in co-constructing knowledge through interaction over time (Jorg, 2000), emphasising the important role of variance, encountered through this interaction, as both source and product of cognition (Bloom, 2001). The 'rules' or internal models or schemas that are spoken of in complexity can, amongst other manifestations, be interpreted in reflective learning as 'assumptions' that, consistent with complexity, are enacted. Acknowledgment and challenging of assumptions is an integral component of reflective learning as participants are encouraged to explore their assumptions through interaction with others or through provision of reflective prompts, new ideas, and dissenting perspectives. While it may, at first, seem as though the process of individual written journaling might be at odds with notions of co-construction of knowledge this is far from the truth. Journals allow opportunity for students to draw from interactions with, observations of, and support from a wide range of authentic sources in contexts, which themselves are continually changing. Acknowledging and embracing students' non-institutional learning as both valid and valuable is consistent with the 'enactivist' model of cognition (Sumara & Davis 1997a; 1997b). Learning does not take place as a result of 'teaching' but rather through a complex interplay of experiences, relationships and ideas being worked and reworked through the process of reflection.

Reflective Journals as an Approach to Research

Beyond being a valuable approach to teaching, learning and assessment, reflective journals also provide a valid method for researching teaching and learning. As was flagged in the introduction to this paper, a previous publication (Phelps & Hase, 2002) highlighted the theoretical and methodological connections between complexity and action research, of which reflection is a key component (Kemmis & McTaggart, 1988; Winter, 1989). One point in particular from this paper might be emphasised. Action research explicitly embraces participation and the democratisation of knowledge production and use (Onn, 1998) and can be seen as a form of practice that acknowledges that social interactions like teaching, learning and knowledge generation, take place between and between among (Grund, 1995). In

this sense, action research is not seen as research *on* participants, but research *with* participants. Action research provides a vehicle for researcher and co-researchers (the participants in the research) to seek and to share meanings constructed from shared experience. 'By moving researchers from the role of objective observers into a collaborative relationship with research subjects, they share in rather than control the production of knowledge' (Brooks & Watkins, 1994, p. 8). These notions are consistent with complexity, which highlights the active roles played by participating agents in co-constructing knowledge through interaction over time. Reflective journals are consistent with these principles in that they allow a dialogue between students, teachers and researchers and hence a co-emergence of new understandings and knowledge that is of benefit to all participants. As Sumara and Davis (1997b, p. 301) note, 'action research becomes an instance of 'complexifying' the relationship among researchers and research situations so that the boundaries between these are blurred'.

Journals can provide a method of gathering qualitative (and sometimes quantitative) data from our learners, as well as from ourselves as teachers and researchers. In researching the learning experiences of students and their reactions to various life and learning experiences, journals provide key insights that can be difficult to document in other ways. They provide an opportunity to capture reflective insights (sometimes described as 'a-ha' experiences), which can have a highly significant impact on learners and might be understood in complexity terms as potential bifurcation points. Understanding the nature and effect of such a-ha experiences is very important for teachers, yet data on these types of experiences is very difficult, if not impossible, to collect. The researcher is rarely present to observe critical points of learning bifurcation, and even if they were, may not recognise the significance of the events for the individual or group involved. In fact, the learners themselves may not be aware of the significance of an event until they 're'-flect on it. Being encouraged to do so through the stimulus of a journal not only documents such moments but also actively engages individuals in being more self-aware of their own learning—something that lies at the heart of metacognition (as defined and discussed later in this paper).

Furthermore, journals provide a means of documenting the interplay of students' history with their current and emerging learning state. As was previously mentioned, this allows learners to explore their own 'sensitivity to initial conditions', as well as providing teachers and researchers alike with insights into these influential factors and the complex influence they exert on a learners' values, attitudes, beliefs and behaviour.

One additional point might be made in relation to reflective processes as a research approach. According to complexity, the input of a new idea, individual or action into the system at any point can lead to dramatically

different outcomes; outcomes that cannot be predicted. Consistent with complexity, introducing ideas, experiences, questions or other forms of stimuli as reflective prompts can be seen, in research terms, as deliberately introducing noise into a system and actively promoting disequilibrium to see what happens (Lissack, 1999). Journals are, thus, not just about gathering data but of actively prompting change, by challenging individuals to reflect on new ideas, concepts and theories and to engage in action. It is from this dissonance that change and learning itself emerges. Such an approach should not be mis-construed as experimenting with causal connections, but rather, consistent with both complexity and action research. This approach is concerned with possibility theory rather than predictive theory—with making the future rather than predicting it (Wadsworth, 1998).

A Case Study of Reflection in Action

I have been using reflective journals for six years as both a learning and assessment strategy, as well as a data collection approach in several research projects. By way of illustrating how reflective journals might support complexity-based teaching, this section will briefly describe my own teaching context before I share an example of one participant's experience within this learning environment. While I have employed these approaches in courses at both undergraduate and postgraduate level, the particular course I will draw from in this paper is offered to practicing teachers through Southern Cross University's Master of Education program.

The course, titled *Educational Information Technology for the School Practitioner*, focuses on enhancing teachers' computer confidence, skills, and knowledge and their integration of information and communication technology (ICT) in their teaching practice. It has been offered as a professional development experience to five cohorts of forty teachers from a local education system. The course extended over a period of two school terms and involved participants in attending two one-day workshops, interacting with a self-paced print and CD-ROM/Website resource and participating in online communication. The Web-based resource is non-linear in nature (Phelps, 2003), covering background knowledge, skills, activities, integration ideas and prompts for reflection. Teachers choose which aspects of the course materials are most relevant to their needs, and interact with these resources at a time and pace relevant to them. It is also explicitly acknowledged that a significant portion of their learning will occur as a result of day-to-day classroom practice and personal experiences involving ICT. Hence, the 'teaching' implicit in the workshops and learning resources is not conceptualised as 'causing' learning, but rather as providing a strategy, scaffold and an impetus for learning.

An explicit intension of the course is to foster the development of capable (as opposed to competent) computer users (Phelps, Hase & Ellis, 2005); learners who are capable of continuing to learn throughout their career. The notion of lifelong learning (Candy, Crebert & O'Leary, 1994; Chapman et al., 2003) is particularly important in contexts of rapid change, such as is implicit with ICT where an understanding of 'how' to learn by using specific cognitive skills and strategies distinguishes expert learners from novices who may have an equal unfamiliarity with the content of the domain (Ropp, 1998).

A metacognitive approach has been developed and incorporated to support teachers in 'becoming' capable computer users (Phelps & Ellis, 2002a; 2002b; 2002c; Phelps, Ellis & Hase, 2001; Phelps, Graham & Kerr, 2004). Metacognition refers to 'thinking about thinking' or 'learning about learning'. It refers to knowledge concerning one's own cognitive processes, and the active monitoring and regulation of these processes in the pursuit of goals (Flavell, 1976; Papaleontiou-Louca, 2003; Paris & Winograd, 1990). The metacognitive approach to computer learning is founded on the premise that adoption and integration of ICT by teachers is influenced by their attitudes, beliefs, values, motivation, confidence and learning strategies. Founded on notions of self-regulated learning (Zimmerman, 1986; 1994; Zimmerman, Bonner & Kovach, 1996) and the 'expert learner' (Ertmer & Newby, 1996), reflection is central to the metacognitive learning process.

> As a powerful link between thought and action, reflection can supply information about outcomes and the effectiveness of selected strategies, thus making it possible for a learner to gain strategy knowledge from specific learning activities. Whereas metacognitive knowledge might be regarded as the "static" knowledge one has accumulated regarding task, self and strategy variables … reflection is believed to be a more active process of exploring and discovering. (Ertmer & Newby, 1996, p. 14)

The metacognitive approach encourages learners, through reflection, to look for opportunities that disequilibria might present for 'evolution' or learning (Gough, 1999). In other words, it works from the basis of learners identifying their own learning needs and goals and using real-life opportunities and contexts as the basis for their learning. In this particular course the metacognitive process is scaffolded through the first one-day workshop and a print-based Thinking module, which provides a series of provocative prompt questions, together with ideas drawn from theory and my own action research with prior students. In terms of assessment, participants are required to keep a reflective learning journal that documents their own development throughout the course, together with their application of the theory and knowledge they gain to their personal and professional setting. In this way assessment is not seen as separate from the learning process.

The structure and form of this journal is left very open and the guidelines are broadly to:

- reflect on their own metacognitive processes when learning about new technology, including experiences learning online and interactions with their mentor(s);
- identify and discuss their personal goals, incorporating skill, knowledge, attitudes and/or value development and provide documentation (including sample work) of their development and progress on these goals;
- reflect on at least one classroom-based or school-based initiative in which they have engaged in and that is appropriately challenging to them.

The constraints of this paper cannot do justice to the course, particularly in depicting its non-linear nature, the ways in which it promotes emergent learning, and 'possibilities for shared action' (Sumara & Davis, 1997a). Many of these aspects of the online course materials are discussed elsewhere (Phelps, 2003). Rather, this paper will focus on the role that reflection plays in the learning process, and particularly on presenting a single story of one teacher's learning journey, as documented through her journal. This case study will be used to illustrate in a very tangible way the theoretical perspectives offered in the previous section.

Wendy's Story

Wendy, like many of the participants in the course, was from a small rural primary school in northern New South Wales, Australia. At the beginning of the course Wendy self-diagnosed her computer abilities as 'fairly basic'. She described her word processing skills by saying that she could 'type and change the font and size, but that's about all'. She was not confident with file management; 'I don't understand files enough and can save but often things are all over the place'.

At the beginning of the course Wendy was required to consider her personal learning goals and she made quite a list, including to 'become more independent in my use of and interaction with ICT'; to 'fine-tune my e-mailing skills'; to 'become more confident and take more risks when dealing with ICT'; to 'go to the computer lab with my class and do something! (This is a scary one)' and to 'familiarise myself with PowerPoint and *maybe* (triple underlined) present something to my class or the staff'. While the course encouraged participants to set goals in order to self-direct their own learning it also emphasised that these goals could and would remain fluid and ever-changing. For instance, after engaging with one of the readings in the course (Ferdig, 1998), Wendy embraced an additional goal to develop

the 'ability to walk into most technology situations and not necessarily know everything that is happening, but not being afraid to try'. As will be further illustrated in this story, Wendy's own school and class context also provided stimuli, which took her learning in initially unforeseen directions. The approach taken in the course thus acknowledged the unique contextual factors influencing Wendy, and allowed her to channel her learning in quite different directions to those of other course participants.

The course prompted teachers to identify people around them who might act as mentors. Encouraged to consider the type of support that is most beneficial to her learning, Wendy reflected that the IT person at school 'has often been very helpful but is someone who tends to do the work for me—move over. Give me the mouse.… I never seem to retain much'. After considering other options she noted that 'others who have IT knowledge on staff are people I find a little threatening and I wouldn't like to ask for advice'. She finally identified her husband as a good mentor. Reflective learning prompts learners to acknowledge the web of authentic support structures around them, breaking down perceptions of learning as an institutionalised interaction between teacher and student, or as contained within a set curriculum or set of course materials. Consistent with this, participants' journals frequently document their 'awakening' into wider ICT awareness, beyond the context of the course and its support resources. Wendy, for instance, realised, when reading the weekend newspaper, that 'there is a whole section of the paper devoted to IT that I avoid. Speaks volumes about my attitude'. This a-ha experience was quite profound for Wendy and she began reading that section each Saturday, including snippets throughout her journal. This is indicative of the value of reflective journals in embracing students' learning from stimuli other than the formal course content, structure or process, encouraging learners to value this learning as valid and hence fostering independent life-long learning.

Prompted by ideas and questions related to problem-solving and volition, which were embedded in the Thinking module, Wendy identified that an attitudinal impediment to her learning lay in her perseverance; 'If something goes wrong, I'll give up'. Later Wendy 're'-flects on these initially expressed thoughts and identifies her patterns of balancing help-seeking and problem-solving strategies as an impediment to learning: 'I've been … berating myself for being too proud to ask for help…. Why is it so?... I am a very good Primary school teacher. I pride myself on it and usually *I* am the one who is the 'expert' on things.… I like sharing ideas and being the mentor myself. So an impediment to my learning—*Pride'.* In these journal extracts we see Wendy exploring her history of computer learning, her beliefs and assumption and how these initial conditions impact on her current approach to technology. While in the past she had relied on help that was fast

and readily provided, she identified aspects in these dynamics as unhelpful to her learning and that an appropriate balance of support and independence was critical to her learning success. Wendy embraced the need for change—to move to a more active role in her learning despite the fact that this would lead to increased personal challenge. In fact, this preparedness to step outside the safety and security of directed learning represents a preparedness to embrace disequilibrium and can be seen as a necessary step in fostering learning capability.

The experiential learning embraced within the learning process meant that Wendy's authentic professional and personal environments were acknowledged as not only an important but a *central* location for computer learning to occur. Throughout the course Wendy engaged with a wide range of technologies and implemented many different initiatives in her classroom. For example, she was prompted to learn to use a spelling program with a few tips from a student who had it at home, and she then used the program with her class and inspired another teacher to do the same. She relearnt how to attach a document to an e-mail and began sending files to her mother, something that she had previously been avoiding.

A major area of achievement for Wendy was using PowerPoint. Initially she rose to the challenge of presenting a slide-show to her class that had been produced by a colleague. In the process Wendy used a laptop for the first time and overcame significant fear and uncertainty when she realised that the laptop had a different 'mouse'. This proved to be a pivotal a-ha experience for her (in complexity terms, a bifurcation point) as she realised that, through perseverance, she was able to succeed in unfamiliar and problematic contexts. Reflecting later she acknowledged the impact this had on her reaction patterns and problem solving strategies and her journal documented her sense of achievement; 'I was so pleased with myself that I made my class watch it twice!' Notably, this experience would have been unlikely to have been as pivotal had a teacher or other 'expert' been present at the time. It was Wendy's independence and the quite unexpected and unpredictable problems that arose that made it significant. Wendy later went on to create her own PowerPoint presentations through play and self-discovery.

Wendy's journal also captured an incident where she assisted a colleague to learn to create favorites. Beyond gaining satisfaction from helping another, her journal noted her enhanced consciousness of the need to 'come across in a non-condescending manner' as well as the confidence this incident brought her in terms of being able to support others.

Another illustration of the capacity for reflective journaling to capture emergent learning lies in Wendy's description of her progress in using e-mail. She recounted a story of visiting a travel agent but being required to go back and pick up documents later in the day … unless you have e-mail.

'My first reaction was to say I'll come back in but I resisted!' Not only did she overcome the initial hurdle of remembering her e-mail address, but she received the document and then embraced the next step of forwarding this to her traveling companion. No degree of directive teaching could 'cause' Wendy to have embraced this learning opportunity. As the journal progresses, Wendy proactively communicated via e-mail and talked to the school principal about using a bottle of wine as an incentive prize for encouraging e-mail usage through the school. Wendy went on to engage her class in a key-pals (e-pals) initiative. This was a huge achievement as she overcome concerns about stalkers, paedophiles and security, as well as some peer discouragement. Wendy's journal provides a 'snapshot' of the rich, emergent learning for her class. The English class with whom they were matched mentioned that they were located close to Stonehenge and her Wendy's students inevitably asked 'what is Stonehenge?' Using a newly set-up computer and data-projector at the front of her room, Wendy went directly to Google, typed in 'Stonehenge' and 'up came site upon site instantaneously. We were able to look at photos, maps, history etc. Instant learning'.

Through the metacognitive and reflective process, ICT learning is perceived and projected as more than just skill development. It is about attitudes, values, beliefs and learning strategies. ICT learning has no 'beginning' and no 'end' and explicating this promotes lifelong ICT learning. Learners are encouraged to 'submit' the journal at some point, but not to see this as an end-point to the learning journey. The 'awakening' to this complexified understanding of ICT learning is well expressed in Wendy's journal.

> Previously I have viewed ICT as "a mountain to be conquered", a finite source of knowledge to be memorised, but I'm moving toward (I think, I hope) a large shift in my attitude!! And that's what it's all about… ATTITUDE! Having the *confidence* in myself to have a try at things I don't understand, to try new things, to search for help, to ask for assistance.

These examples of Wendy's learning activities demonstrate how the approach is consistent with complexity. Most ICT professional development programs in schools are driven and directed by the more ICT literate teachers, yet in Wendy's story we can see that encouraging teachers to engage reflectively with their complex history and experiences *and* to set their own goals and identify strategies for achieving them, can lead to more personally appropriate and far richer learning. As Wendy's story illustrates, journaling provides scope for learners to shape their learning activities in response to emerging need and local context. The teaching is not driving, and certainly not *causing* learning, but rather is encouraging and supporting it. Reflection prompts participants to follow learning pathways most

appropriate to *them* and provides scope for students to diverge from their initial goals; to embrace emergence and 'go with the flow'. Journaling this process produces tangible learning outcomes that are able to be assessed. It also produces data, which allow researchers insights into the highly individual learning experience.

Issues with the Use of Reflection

While Wendy's case study illustrates the potential of reflective journaling in facilitating, documenting *and* assessing learning, there are a number of limitations of journals as sources of data. Issues relate to students' preparedness to write openly or their tendency to write what they think the teacher wants to read (Boud & Walker, 1998; Kerka, 1996). The self-reported nature of journal data might be considered a further limitation to their use as a research tool. However, within a constructivist framework (and consistent with complexity), data are themselves narrative constructions of experience and we can only claim to have interpreted a reality 'as we understood both our own experience and our subjects' portrayal of theirs' (Charmaz, 2000, p. 523). Reflective journals are an ideal tool to document this shared reality.

Learners' preparedness and capacity to engage deeply with their learning experience also influences both the quality of the reflection and the quality of the resultant learning. Palmer, Burns and Bulman (1994) note that the depth of reflective engagement can be influenced by past learning methods and traditional attitudes toward education. Good reflective learning still requires good teaching, particularly in terms of providing stimulus or 'noise', which promotes disequilibrium, so that learners might 'learn'. As McGill and Weil (1989, p. 248) point out, facilitators 'play a key role in enabling learners to reflect critically on their experience' and there is a need for both instruction *and* inspiration to develop skills of reflective journaling (Campbell-Evans & Maloney, 1998).

As an assessment approach, some may find reflective journals to be problematic. However in countering such perceptions Jonassen et al. (1997), for instance, draws on ideas inherent in Quantum physics to argue that 'any effort to measure phenomena can never be certain, that the act of observation intervenes and changes that which is being observed... we can never know with certainty if or why students learn... therefore we can never be certain of what will happen when we intervene in any process'. These authors argue that it may be just as important to understand students' perceptions of their own abilities and their confidence in these abilities, as it is to obtain a raw score of academic standing. This is exactly what reflective journaling provides.

Conclusion

This paper has provided an exploration of the potential of reflective journals both as a pedagogical strategy *and* as a research approach, which are consistent with the tenets of complexity. In the rapidly changing ICT environment that my course seeks to prepare teachers for, reflective-based teaching approaches have proved to be a powerful means of fostering lifelong learning and empowering teachers to deal with a complex, ill-structured world (Jonassen, et al., 1997). As Wendy's story illustrates, reflective journals provide a means of marrying learning in institutional and non-institutional contexts, and form an authentic assessment approach, which embraces and welcomes diversity in thought and action. However reflective journals can also provide significant potential for us as educational researchers working with the ideas proposed by complexity. They can form a means of communication between students, educators and researchers, promoting a narrative approach to both research and teaching. As a research tool reflective prompts can be designed to challenge participants' schemas, thus prompting disequilibrium in order to 'see what happens'. Reflective journals provide the opportunity for researchers 'to look at a phenomenon while it is evolving... to look at the potentially myriad variables that might be coming into play as they occur' (Hase, 2002). As an active process of exploration and discovery, reflection often leads to very unexpected outcomes (Boud, Keogh & Walker, 1985) and journals can capture such insights 'in action'; insights, which can be difficult to gain in other ways. Journals embrace participants' involvement in their own interpretation of the 'data' but, beyond that, also provide a vehicle and outlet for the organisation and reorganisation of subjective experience and the 'co-evolution of jointly constructed reality' (Stacey, Griffin & Shaw, 2000, p. x). Hence, reflective journals can become a tool not only for documenting (and researching) learning, but enhancing and stimulating it. There remains much scope to explore these ideas further in both theory and practice, and it is hoped that this paper might offer an invitation for others to discuss and play with the potential of reflection in their own educational contexts.

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About the Author

Renata Phelps is a lecturer in the School of Education at Southern Cross University, Australia. Her teaching focuses on the use of information technology to support education in primary, secondary and tertiary educational contexts. Her action research has led to the development of a metacognitive approach to computer education, which is

currently being trailed within a mentoring framework as an approach to whole-school change in ICT professional development. Renata's teaching and research is informed by complexity theory. Postal address: School of Education, Southern Cross University, P.O. Box 157, Lismore, NSW Australia. Fax: +[61-2] 662221833. E-mail: rphelps@scu.edu.au

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