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Woven into the fabric of experience: residential adventure education and complexity

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Residential adventure education is a surprisingly powerful developmental experience. This paper reports on a mixed-methods study focused on English primary school pupils aged 9–11, which used complexity theory to throw light on the synergistic inter-relationships between the different aspects of that experience. Broadly expressed, the research question was how (if at all) do pupils change following a residential adventure education experience, how does any change relate to their experience during the course and what are the implications? Qualitative findings suggest that the process of personal development through residential adventure education is a complex system, in which transformative step changes arise in some pupils as a natural and possibly inevitable consequence of the complex nature of the process. Quantitative findings include evidence that the number of schools that offer residential experience is increasing but that fewer opportunities are available in schools with more deprived catchment areas. An instrument to assess the impact of a residential experience on pupils was designed and tested, showing four reliable components: living with others, challenge, teacher relationships and learning about self. Pupils' classroom attainment was significantly correlated with their perception of the impact of the course. There was a significant improvement in prosocial behaviour and a significant reduction in self-perceived hyperactivity from pre-course to post-course.

Keywords: *Residential; Adventure; Education; Complexity; Non-linear*

Rationale and researcher positionality

In England there is no entitlement to any form of adventure education. Moreover, political responses to the 2009–2012 financial crisis have led to a drastic reduction in national and local government funding. While demand for adventure education from those who can afford it is resilient, there is a real risk that those who cannot afford

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to participate without financial support will be prevented from doing so. From my experience in political lobbying for greater opportunities to participate in adventure education, it is clear that further robust evidence is urgently needed in order to build a persuasive case. A key motivation for this study was to develop such evidence.

That motivation was an important factor when developing a philosophical position from which to tackle the study: practical utility was vital. This was complicated by the fact that I am open to a range of ontological viewpoints. On the one hand, I am sympathetic to Pring's (2000) view that it is possible to make generalizations about people and groups that can be expressed as facts and to attribute causality to social interactions. On the other hand, I accept the constructionist view that 'meanings are constructed by human beings as they engage with the world' (Crotty, 1998, p. 43).

A forced choice between an objectivist and a constructionist epistemology did not therefore appeal. Instead, it was necessary to find a philosophical perspective that spanned these disparate views. Pragmatism provided the solution: it reconciled my wish to acknowledge a non-positivistic objective reality with the constructed nature of individual perception. 'In a pragmatic approach, there is no problem in asserting both that there is a single "real world" and that all individuals have their own unique interpretations of that world' (Morgan, 2007, p. 59). Pragmatism is not about abandoning beliefs or principles; it is an expression of the belief that, providing the arguments behind adopting a particular approach can be justified, practical utility is more important than adhering to metaphysical constraints.

Pragmatism has the advantage that it allows a range of methodologies. In order to develop an understanding of the process of adventure education, a rich, in-depth description is helpful. It is therefore understandable that there has been an emphasis on qualitative research in recent years. However, qualitative research alone cannot provide the comprehensive evidence base that is needed to influence policy. My solution to this dilemma was to use mixed methods. Mixed methods have the advantage that they combine the quantitative evidence that has more potential for influencing some important policy-makers with the fuller, richer description that qualitative research can provide.

Strong claims about the benefits of adventure education are often made, sometimes without supporting evidence. For example, OFSTED, the body that inspects and regulates schools in England, claims that, 'When planned and implemented well, learning outside the classroom contributed significantly to raising standards and improving pupils' personal, social and emotional development' (OFSTED, 2008, p. 5). However, there is very limited research evidence to that effect and it is unclear how OFSTED's inspectors came to that judgement.

Moreover, there is currently a higher level of demand for residential adventure education than might be thought likely in the current economic climate. Despite the cost and the perceived obstacles (Power, Taylor, Rees, & Jones, 2009), many schools seem determined to continue to give their pupils that experience. One reason may be because it has a developmental impact that is surprisingly powerful. This study sought to explore exactly what the impact is for primary school pupils aged 9–11.

The study did so by focusing on the way in which pupils' classroom behaviour changes following a residential experience. A deliberate decision was made not to use 'intermediate' outcome indicators such as self-esteem but to try to understand more directly how the experience impacts on attainment and other aspects of classroom behaviour. Primary school pupils were chosen because the use of residential courses by primary schools is increasing, yet relatively little research has been carried out on that age group.

In the literature it has often been noted that the combination of adventure and residential experience appears to have an impact on pupils that is disproportionate to the apparent effect of the individual elements. For example, Hattie, Marsh, Neill, and Richards (1997, p. 73) state: '... there is a rhetoric that the adventure program is a gestalt and that the whole is therefore more than the sum of its parts ...'. Complexity theory has the potential to help us to understand better this apparent synergy between the elements of the experience.

Complexity theory

References to chaos and complexity theory are few and far between in the adventure education literature. Higgins (1996) has suggested that chaos theory provides a good analogy for the process of personal development. I agree, but argue that complexity theory sheds further light on the process. First, it is necessary to differentiate between the two.

Smitherman Pratt expresses the difference succinctly: 'Essentially, complexity theory is the study of order emerging from disorder, while chaos theory is the study of disorder emerging out of order' (2008, p. 125). Chaos theory is primarily about deterministic chaos caused by the non-linear interaction of a relatively small number of equations (Cilliers, 1998). The behaviour of a chaotic system can be extremely complicated but is, in theory, predictable, given knowledge of the initial conditions. In contrast, complexity theory is generally held to be non-deterministic and has been defined as, 'a system that is comprised of a large number of entities that display a high level of nonlinear interactivity' (Richardson & Cilliers, 2001, p. 8). As a result of the non-linearity, complex systems behave in an unpredictable way and give rise to some unexpected phenomena.

Chaos and complexity theory are both examples of non-linear systems. Linear systems can be studied in a reductionist, Newtonian way. Non-linear systems, in which causality is far from obvious, cannot. Social processes are clearly much more subtle than a simple linear system. Studying them through the lens of non-linear chaos and complexity theory can therefore cast new light on the processes.

Before considering complexity and non-linearity in more detail, I will outline some ideas from chaos theory: phase space, attractors and phase shifts. Phase space is an abstract 'space' in which all possible states of a system are represented, with each possible state corresponding to a point in phase space (Byrne, 2002). A plot of the variation of the system over time shows its evolution. Within phase space, an

attractor is a stable state into which systems that are initially located within its basin of attraction eventually 'fall'.

Particularly relevant to adventure education is the process of moving from one attractor to another, known as a phase shift. This phrase derives from the non-linear change of phase from liquid to solid or gas at a substance's freezing and boiling points. A similar non-linear change can be seen in many human contexts. Watts (2006) suggests that an increase in perceived risk might precipitate a phase transition in a pupil. However, the concept has not to my knowledge been applied previously to the broader process of personal development. In the discussion, I argue that the development of self-confidence can be seen as a phase shift and use another concept from chaos theory, a cusp catastrophe, to illustrate this.

Returning to complexity, numerous authors list characteristics of a complex system (e.g., Cilliers, 1998; Davis & Sumara, 2008; Morrison, 2002). Drawing on all these, the most important characteristics from the perspective of this study are the richness of interaction between the many elements involved, non-linearity, recursive feedback loops, 'bottom up' emergence (adaptive self-organization in which the system develops without centralized control), the degree of disequilibrium needed, unpredictability and the multi-factorial nature of a complex system.

Richness of interaction is present within any social context. However, the scope for interactions for the participants on a residential course is significantly greater than in a classroom context.

Non-linearity has a number of implications. First, it implies that the behaviour of the whole cannot be reduced to the sum of its parts (Nelson, 2004). Second, it guarantees that small changes can have large results (Cilliers, 1998). Third, it opens up the potential for transformative change: step changes in behaviour (Nowak, 2004).

Recursivity within the system helps to create the instability that is needed to produce such leaps. Negative feedback is commonly used in cybernetic control systems, where the feedback acts as a stabilizing influence on the system to return it to a desired state. In contrast, positive feedback, which is a particular feature of complex systems, can have a destabilizing effect. Gilstrap (2005) has shown that positive feedback in an educational context can increase the connectivity within a group of people, leading to emerging self-organization of the system.

Emergence is a particularly exciting property of complex systems in which new behaviour or collective properties occur spontaneously and automatically simply as a result of the complex interactions within the system, rather than in response to specific causal factors (Haggis, 2008). This contributes to the dynamic and evolving character of a complex system.

Disequilibrium is essential for the survival of complex systems: they must be open to their environment and capable of importing energy from it, forming a dissipative system in which energy imported from the environment is converted into added complexity (Byrne, 1998). In the original description of dissipative systems, energy was used in a scientific sense but, if imported energy is used broadly to mean an external input that can have an effect on the state of a system, the principle can be applied to social situations. For example, Doll (2008) shows in an educational context that

systems must retain just the right amount of imbalance to maintain their creative and transformational potential. Complexity theory suggests that the optimum balance between stability and adaptability is on the edge of the phase change between the two. Indeed, Kauffman (1995) considers that complex adaptive systems might automatically evolve to the edge of chaos.

A consequence of the imbalance is a degree of unpredictability that is characteristic of complex systems. Finally, an important aspect of a complex system is that the relationship between the components is more important than the components themselves (Davis & Sumara, 1997). It is impossible to isolate key factors because all of the factors work together. Complexity 'articulates a notion of causality that is multi-factorial' (Haggis, 2008, p. 165).

This study shows that every one of these characteristics of a complex system is evident in the process of residential adventure education.

Methodology and research questions

A number of critiques of the adventure education literature helped to shape the study. Barrett and Greenaway found a lack of data concerning developmental outcomes and considered that there had been a lack of emphasis on the process. They also regretted that much research 'cannot be generalised to other situations because of its programme-centred nature' (Barrett & Greenaway, 1995, p. 53). Hattie et al. (1997) suggested that research might investigate the relation between programme characteristics and outcomes. Thomas, Potter, and Allison were 'struck by the disparate nature of some research and the noncumulative development of literature' (2009, p. 26). Shooter concluded that: '... the body of empirically informed adventure education literature offers evidence that supports the fundamental effectiveness of adventure programming, but cannot yet communicate a complete understanding of why programs are effective' (2010, p. 290).

Drawing together these observations, I was determined to pose research questions that would:

- build on previous research,
- look beyond intermediate variables such as self-esteem to real behavioural outcomes,
- look at process as well as outcomes,
- attempt to understand more about why programmes are effective, and
- be generalizable across various contexts, rather than being programme-centred.

Sibthorp (2003) has (with older students) established that it is possible to measure characteristics of the experience in a meaningful way and to relate these to outcomes. McKenzie (2003) also related participants' perceptions of the impact of various course components to outcomes. It seemed that there was potential in building on the methods used by Sibthorp and McKenzie, but with an approach tailored to younger pupils. These considerations led to the following three-phase research design.

Broadly expressed, the research question was how (if at all) do primary school pupils change following a residential adventure education experience, how does any change relate to their experience during the residential and what implications does that have for the provision of residential adventure education?

- Phase 1 was quantitative, and tested the hypothesis that there is a correlation between the extent of residential opportunities in English primary schools and school performance measures.
- Phase 2 was qualitative: an exploratory study to discover the perceptions of primary school head teachers, parents and policy-makers on what impact a residential adventure programme has on pupils' subsequent behaviour and to explore the factors that contribute to this.
- Phase 3 was quantitative and was informed by the findings of phase 2. It tested an instrument to assess the impact of a residential experience on pupils and tested the hypothesis that there is a correlation between that impact, their classroom attainment and their social and emotional development.

There is a brief explanation of the statistical terms used in phases 1 and 3 at the end of the article.

Phase 1: school-level data

Phase 1 drew on publicly available school performance data: the OFSTED gradings for pupil achievement (OFSTED, 2010b). A survey was used to establish the extent of residential experience offered. In order that the findings could be generalized to the population of English primary schools, a stratified random sample was used, stratified by the OFSTED grading. A total of 260 schools were circulated, 65 from each of the four OFSTED gradings. In order to maximize the response rate, the questions were kept as simple as possible: the key question that schools were asked was how many nights away on residential activities their current Year Six pupils will have had the opportunity to experience during the whole of their time in Key Stage 2. At the end of Year Six pupils are aged 11, and Key Stage 2 covers the preceding four years (2007/08–2010/11).

A total of 154 phase 1 questionnaires were returned without prompting. Telephone follow-up of schools that did not respond initially resulted in final responses from 249 (95%). Despite the adverse economic environment, a large number of schools offered at least one residential experience. Weighting the proportion of schools in each category by the national proportion of schools in those categories leads to the conclusion that 95% of English primary schools offer at least one residential experience. Applying a confidence interval calculation that is appropriate for a stratified sample, the 95% confidence interval is $\pm 5\%$. This is a considerable increase from the most recent reliable figure of 86% (Scout Association, Duke of Edinburgh's Award, & DfES, 2004), although it is of course possible that the ongoing economic pressures may cause that figure to fall back.

Rather to my surprise, there was a small but statistically significant correlation between the extent of residential opportunities offered and the school's OFSTED results ($\rho = 0.169$, $p < 0.01$, one-tailed, using a Spearman rank correlation). However, there was also a clear inverse correlation between the proportion of more deprived pupils who are entitled to free school meals and the extent of residential opportunities offered ($\rho = -0.289$, $p < 0.01$, one-tailed, using a Spearman rank correlation). When a partial correlation was carried out between the extent of residential opportunities and OFSTED results while controlling for free school meals, the apparent relationship between residential opportunities and OFSTED results became insignificant.

One interpretation is that schools serving deprived communities that have a high proportion of pupils on free school meals cannot raise enough money from parents to run as many residential courses and, at the same time, are unable to 'break the cycles of low achievement that often blight such communities' (OFSTED, 2010a, p. 37). In other words, deprivation may well be the root cause of both phenomena. Although the research design cannot support any causal inference, another possible interpretation could be that a residential experience stimulates an improvement in attainment that is recognized by OFSTED in the form of higher gradings. If this is the case, then the fact that parents in more deprived communities cannot afford to support residential courses may be a contributory factor in the schools' poorer average OFSTED performance.

Phase 1 of the study clearly could not help to decide between the alternative possibilities. However, regardless of the uncertainty about the underlying cause, the fact that the extent of residential provision is clearly linked with deprivation is very helpful in terms of arguing the case politically for financial support for those pupils who would otherwise not be able to afford the experience.

Phase 2: adult perceptions

Phase 2 formed the qualitative core of the study. It consisted of a series of semi-structured interviews, which were recorded and transcribed. They were analysed using a grounded theory approach, in which theory is developed inductively from the data, in contrast to using a pre-conceived theoretical framework. Interviewees included 10 head teachers, five parents and two ex-Secretaries of State for Education. Views expressed by the ex-Secretaries of State will be reported elsewhere.

Interviews yielded a huge volume and diversity of responses, from which I attempted a synthesis of aspects of the process that contribute towards the impact. These include the following:

- complexity arising from the many interacting influences;
- the nature of the learning environment, including:
 - additionality, and
 - excitation;

- energizing influences, including:
 - challenge, and
 - the social dimension;
- catalytic factors, including:
 - the importance of the affective nature of the experience, and
 - holistic—holistic nature of the experience; and
- cementing factors, including:
 - memorability, and
 - the intrinsic nature of the reward and its effect on motivation.

Complexity is best illustrated by considering the other elements and noting the way in which they interact with each other.

Additionality includes an element of new space, in both physical and interpersonal terms (Simpson, 2007). There is also a very different quality of time, in which the 24-hours-a-day involvement creates more opportunities to see others in a new light and to start to understand them better.

Excitation is a concept borrowed from quantum theory, where injection of energy into a system enables a quantum leap to a new energy state. In personal development terms, it can have a similar effect. An injection of energy of this sort can be seen as creating a far from equilibrium situation. This is precisely the environment in which a complex system demonstrates new, emergent behaviours (Prigogine, 1996). To achieve an optimum degree of disequilibrium is of course part of the craft of an outdoor facilitator.

Two factors were identified as particularly strong energizing influences: challenge and the social dimension. Challenge is widely recognized as a central element in the impact of adventure education. However, this study showed the vital importance of the interaction between challenge and other aspects of a residential experience and, in particular, how central the social dimension is to the learning process.

Social interactions are not simply an energizer but also a catalyst. There is a wonderful degree of mutual support and encouragement between pupils who are attempting challenging activities. Moreover, positive feedback following success abounds. Recurrency loops that offer positive feedback are a common feature of systems in which emergence of new behaviour and non-linear changes occur. I suggest that the rich interactive environment of a residential adventure course, its constantly changing, open-ended nature and the positive feedback that is an integral part of the experience not only allow non-linear change to occur but make it inevitable that it will occur.

Other catalytic factors include the affective nature of the learning. There is a wealth of evidence that non-cognitive learning can significantly improve academic performance (Durlak et al., 2011). In a fieldwork context, Nundy (1998) showed that cognitive and affective learning reinforce each other. One participant in the current study described this as a 'snowball effect' in which pupils' emotional reaction

to having succeeded at something difficult reinforces the cognitive impact. In other words, rather than simply thinking abstractly that success in one activity might increase the likelihood of success in another, the emotional connotations mean that pupils *know*, viscerally, that they *can* succeed.

Numerous comments from interview participants revealed the holistic nature of the experience:

I've grown to think that the whole experience is what matters.

It's layers of things—I don't think you can isolate the ingredients.

It's the whole combination of everything they've experienced—the new activities, trying something a bit different, a bit new, the reflection, the encouragement from peers, and the success and the feeling that gives them—all of those things . . . everything has an impact.

Finally, cementing factors include memorability and the intrinsic nature of the reward. A common theme from head teachers was how long lasting the memories of a residential experience are and how they provide a 'common language of experience'. Several commented that feedback from adult ex-pupils shows that a residential experience is one of the most memorable aspects of their school career. Memorability appears to be an important factor in achieving transfer of learning.

It is acknowledged that transfer of learning is a contested concept (Brown, 2010). Part of the problem appears to be linguistic. If, instead of looking at it as a metaphor, we simply allow the meaning of the words to extend to describe the holistic developmental process, that helps to defuse the contention. Hager and Hodkinson (2009) suggest that, by using a combination of different lenses to look at the concept, learning can be seen as a relational web in which skills, knowledge and understanding are continually open to change in ongoing transactions with the environment, in a process of becoming. This way of looking at transfer of learning is remarkably consistent with viewing learning as a complex system.

One head teacher's observation that 'It's a buzz you give yourself' highlights the intrinsic nature of the reward. Pupils are not competing for gold stars or praise from the teacher. They simply know that they have achieved something difficult and experience a degree of satisfaction that is arguably deeper than their response to extrinsic reward. Intrinsic reward is more likely to lead to intrinsic motivation, in which 'Children are intrinsically motivated to learn, to undertake challenges, and to solve problems' (Deci & Ryan, 1985, p. 11). Head teachers reported greater self-motivation back in the classroom: 'They get on with it rather than being told to do it'.

Intrinsic motivation relates to the work of Dweck (1999), who contrasts 'mastery orientated' students, who value learning for its own sake and are resilient in the face of difficulties, with 'helpless' students, who are more concerned with their performance than their learning, and respond badly to difficulties. She shows that helpless students are likely to be 'entity theorists', who consider that intelligence is fixed and immutable. In contrast, mastery orientated students are likely to have an 'incremental theory', which holds that intelligence is malleable and that they can change it and therefore influence their own attainment.

I suggest that residential adventure education has the capacity to prove to pupils in a convincing and memorable way that they *are* capable of change, that they *can* do things that they thought impossible and that this may influence them towards an incremental view of their abilities, with a greater resilience towards academic challenges and clear implications for their future learning.

Returning to the way in which the elements of a residential experience interact to catalyse and reinforce the outcomes, here is an example of how that recursive interaction might work:

The new environment and its energizing influence create an openness to new experiences. Working in small groups, pupils want to do well in the eyes of their peers and are therefore persuaded to have a go at something difficult. Support from fellow pupils contributes to success. The emotional impact of overcoming fear creates an obvious sense of achievement. That raises the aspiration of those who might be dubious and gives them the confidence to try. They succeed in turn and the effect is a self-sustaining process of raising achievement.

The self-reinforcing nature of this process could explain what one interview participant saw as ‘a whole shifting of the peer group’, in what I interpret as a description of emergence.

Although they recognized the difficulty of measuring it, head teachers were convinced that there is an impact on attainment. One head teacher noted that project work following the residential experience is ‘probably the highest quality children’s work they do here’. Head teachers also noted the impact on pupils’ social and emotional development, one commenting that ‘the better place that you’re in emotionally, the more you’re likely to learn’. Whether it is possible to make those links quantitatively was explored in phase 3.

Phase 3: pupils’ views

Phase 3 built on the findings of the interview phase to design and test a questionnaire to assess the impact of aspects of the residential experience on pupils. This consisted of 27 statements to which pupils indicated their strength of agreement on a four-point scale. Responses were analysed using principal components analysis to identify the main components of impact. A total of 232 nine-year-old to 11-year-old pupils from nine different schools completed the pupil impact questionnaire. All had completed a five-day residential adventure education course in the summer of 2011.

Inter-statement correlations suggested that the principal components analysis should be carried out with 19 of the statements. A value of 0.895 for the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy showed a high degree of confidence that the sample size was adequate. After varimax rotation, four components of impact were identified and it was possible to ascribe to these clearly identifiable meanings which are shown in Table 1. Using the Cronbach’s alpha test of reliability, each of the components had a satisfactory level of reliability that is also shown in Table 1.

Full details of the pupil impact questionnaire and its analysis are available online (Williams, 2012).

Table 1. Components of impact

	Cronbach's alpha	Area of impact
Component 1	0.820	Living with others
Component 2	0.709	Challenge
Component 3	0.704	Teacher relationships
Component 4	0.724	Learning about self

Attainment progress was assessed by the change in pupils' formative assessment levels in reading, writing and mathematics from pre-course to post-course. The assessments closest to the beginning and end of the residential experience were used, which means that change was measured over a period of between three and six months. Consistency in that period was not critical because the aim was to assess the correlation with pupil impact and not the absolute change in attainment. Attainment results were received from a sub-set of 34 pupils.

Using Spearman's rho, a significant correlation was found between attainment difference scores and Component 1 ($\rho = 0.357$, $p = 0.043$, one-tailed). A marginally significant correlation was found between attainment difference scores and Component 3 ($\rho = 0.343$, $p = 0.050$, one-tailed). There was no significant correlation between the attainment difference scores and pupil impact Components 2 or 4.

Social and emotional progress was assessed by administering the Strengths and Difficulties Questionnaire (SDQ; Goodman, 2001) before and approximately two weeks after the course. This is an instrument with well-established psychometric properties that was particularly attractive because it is a one-page questionnaire expressed in simple language. It is designed to assess the psychological adjustment of children and generates scores on the five sub-scales presented in Table 2. Reliability figures from this study for three of the sub-scales were lower than ideal, and the conduct problems sub-scale in particular was too low to use.

SDQ questionnaires were completed pre-course and post-course by a sub-set of 31 pupils. Scores on the hyperactivity sub-scale were normally distributed but others were not, necessitating the use of non-parametric statistics on all but the hyperactivity sub-scale.

Table 2. Reliability of SDQ sub-scales

Sub-scale	Cronbach's alpha
Emotional symptoms	0.651
Conduct problems	0.625
Hyperactivity-inattention	0.746
Peer problems	0.736
Prosocial (cooperative and helpful) behaviour	0.651

A paired-samples *t*-test was carried out on the hyperactivity data, showing that there was a significant improvement (reduction) in perceived hyperactivity from pre-course to post-course ($p = 0.004$, one-tailed) with a medium effect size of 0.46. A Wilcoxon signed-rank test was carried out on the three remaining usable sub-scales. There was a significant improvement in prosocial behaviour from pre-course to post-course ($p = 0.002$, one-tailed) with a large effect size of 0.64. There was no significant difference in the other scales.

Each of the usable SDQ sub-scales was compared with each of the pupil impact factors using Spearman's rho. One of these appears to be strong and robust enough to allow for possible shortcomings in the SDQ data. This is a correlation between the 'living with others' factor and changes to the emotional symptoms scale ($\rho = 0.517$, $p = 0.006$, one-tailed).

Even though it was hypothesized, it was a pleasant surprise that changes in attainment were correlated with two components of pupil impact. This does not of course imply that the residential experience caused the improvement in attainment: the research was exploratory and not designed to investigate causality. Moreover, findings from this phase cannot be extrapolated beyond the sample. However, it does give sufficient encouragement about the potential of formative assessments as potential outcome measures to propose future research using a quasi-experimental approach in an attempt to establish whether the relationship is one of cause and effect.

A measurable effect on the prosocial sub-scale had been predicted. However, the hyperactivity finding was a surprise. Again, it should be emphasized that the research is exploratory and also that the sub-scale measures pupils' self-perceptions of their hyperactivity. To confirm the effect and to assess whether the relationship is causal, further research is required, ideally using a more objective measure. However, if the finding is confirmed, this has the potential to form the basis of a case for using adventure education as a non-pharmacological means of helping the increasing number of children who suffer from attention-deficit hyperactivity disorder.

The significant correlation between the impact factor 'living with others' and a reduction in adverse emotional symptoms after a residential course was another unexpected finding, particularly as there was no significant change in the emotional symptoms scale pre-course to post-course. That would appear to be because some pupils showed an increase in adverse emotional symptoms between pre-course and post-course measurements and some showed a decrease. While that could be perceived as positive for those pupils who perceived a strong impact and subsequently showed fewer symptoms, it implies an unsettling effect for other pupils. Little research has been carried out on adverse impacts of adventure education, and this finding suggests one possible approach.

Discussion

Drawing together the qualitative and the quantitative findings, there is considerable evidence that the process of personal development through residential adventure education can be seen as a complex system. Complexity is present at two levels. At a

detailed level, not only are there four separate, clearly identifiable components of impact, but those components are themselves composite, made up of a number of varied impact statements. At a higher level of abstraction, those components can be seen to act recursively, mutually reinforcing each other.

A particularly persuasive element of triangulation arising from the mixed-method design was that the two most important contributors (the social dimension and challenge) were the same in both the interview phase and the pupil impact survey. Residential courses engender a particularly rich social interaction that arises through living with others 24 hours a day. Challenge causes disequilibrium and the buzz created by the new experience provides an input of energy. The mutual support that is so evident provides reinforcing positive feedback loops.

These circumstances are ideal for emergence to take place—for new behaviour to arise simply as a result of the complex interactions created by the situation. An immediate implication of emergence is that we can expect non-linear step change and it therefore ceases to be surprising that pupils can experience a dramatic growth in self-confidence. Instead, the fact that such transformative change takes place is a natural and possibly inevitable consequence of the complexity inherent in residential adventure education.

It is clear that any attempt to reduce that complexity to a two-dimensional diagram, even with numerous feedback loops, will inevitably be a simplification. Related to complexity theory, catastrophe theory is one way of illustrating a non-linear transition. Van der Maas and Molenaar (1992), who use it to model transitions between Piaget's stages, describe catastrophe theory as the study of the equilibrium behaviour of mathematical functions that exhibit discontinuous jumps. A cusp catastrophe is illustrated in Figure 1. For the purposes of this illustration, I have labelled the axes attainment, teaching input and confidence.

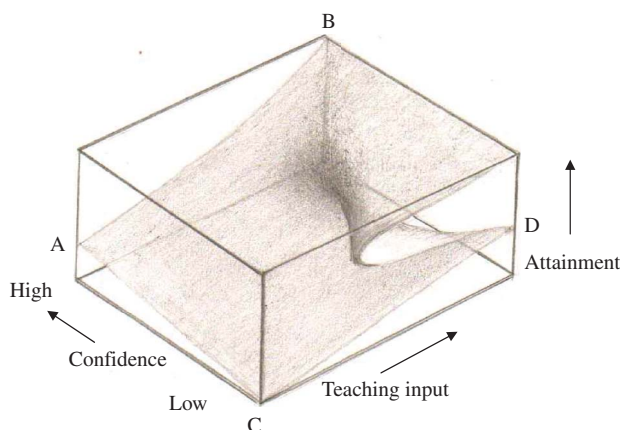


Figure 1. The possible impact of confidence on attainment

Consider first a pupil at point A with a high level of confidence (Figure 1). With added teaching input, that pupil's attainment rises smoothly to point B. Now consider a pupil with a low level of confidence at point C. Added teaching input allows the pupil to progress to an extent but, if the pupil remains on the lower part of the surface, a dead end is reached at point D, after only marginal improvement in attainment. However, a significant change in confidence allows that pupil to reach the upper surface, where attainment is no longer constrained. I suggest that the leap from lower to upper surface is unlikely to occur without some sort of external factor that causes a step change in confidence. My argument is that residential adventure education causes such a step change and that this might in turn allow the pupil to reach levels of attainment that were previously inaccessible.

Turning to the implications for policy, although the findings from phase 1 do not themselves demonstrate a link between residential courses and attainment, evidence from phases 2 and 3 has produced a wealth of evidence that residential courses have a positive developmental impact. Therefore, the fact that schools in more disadvantaged areas offer fewer residential courses (and have poorer OFSTED gradings) is strong evidence in support of the need to allow targeted support (such as the Pupil Premium) to be used to subsidize residential courses for those pupils who would not otherwise be able to afford the experience.

Gough asks: '... how might understanding our worlds and selves as open, recursive, organic, nonlinear and emergent make "a different practice" possible for environmental education research?' (2011, p. 13). Applying a similar question to the practice of residential adventure education suggests new possibilities, most particularly that the many aspects of the experience interact in a way that produces emergent, non-linear, transformative behaviour change. This study has shown that specific elements such as challenge are important in that process but that the impact of those elements is reinforced and catalysed by other aspects of the experience. Although it is vital to include ample opportunities for interpersonal interaction and for challenge, it is also important that providers do not focus on any one aspect to the extent of losing the richness of interaction between the different aspects of a course that leads naturally to the powerful developmental learning experienced.

To make the most of the potential of complex interactions, an instructor should create the conditions for emergence to happen. Strategies to encourage emergence include:

- Maintain an open-ended approach. Do not 'front-load' an experience with specific learning objectives but allow maximum scope for pupils to develop in different ways as they respond differently to the situation.
- Maintain an input of energy, remembering that the energizing influences that can provide this energy include both the element of challenge and the social dimension.
- Maintain an appropriate degree of disequilibrium by presenting a variety of different challenges, ideally at the level that each pupil will find the challenge just achievable.

- Make the most of the way that the different elements of a residential experience interact to catalyse emergence. Recognize the vital contribution of interactions with peers and teachers and make sure there is enough opportunity for these. Create the opportunity for pupils to reflect on their experiences but without leading their thinking down a particular channel.
- Ensure that positive feedback loops exist. Praise effort rather than ability and encourage pupils to believe that they can change their level of achievement by their own efforts.

There have been numerous attempts to refresh the classic model of the process of adventure education and add new insights (e.g., Baldwin, Persing, & Magnuson, 2004). While these are helpful, I suggest that, from one perspective, the process is more complex than existing theories suggest. It is more complex by virtue of the need to recognize that there is a continuous interaction between the elements of the process in which components catalyse and reinforce the impact of each other in a way that cannot be described in linear terms, creating an environment in which new, transformative behaviour emerges.

However, viewed from the perspective of complexity theory, outcomes that might be seen as unexpected from a classical perspective can be understood very simply:

- residential adventure education is a complex system;
- therefore emergence takes place, leading naturally and, for some, inevitably to a transformative, non-linear step change in personal behaviour.

If residential adventure education is seen as a web of influences interacting in a complex and synergistic way, with each individual element woven into the fabric of experience, its powerful impact is unsurprising.

Glossary of statistical terms used (drawing on Field, 2009)

Confidence interval—confidence intervals are used in generalizing from a sample mean to the whole population. A 95% confidence interval indicates that there is a 95% probability that the true population mean is located within the range of the confidence interval.

Correlation—if there is a correlation between two variables, as one increases, so does the other. However, this does not in itself imply cause and effect. Spearman rank correlations are used where the data are rank orders rather than precise measurements. Rho (ρ) gives an indication of the strength of the relationship between the variables. A value of 0.1 is generally regarded as a small effect, 0.3 as medium and 0.5 as large. One-tailed means that the direction of the relationship has been predicted. The figure p is the probability that the relationship occurred by chance: a figure less than 0.05 is usually regarded as giving confidence that the result is not a coincidence.

Non-parametric statistics—these are tests used when data fail to meet the criteria necessary to use the more powerful parametric statistics; normal distribution is one such criterion.

Partial correlation—this is a measure of the strength of the relationship between two variables when the effect of a third is held constant.

Principal components analysis—similar to factor analysis, this is a way of identifying latent variables in a set of data (underlying variables that cannot be measured directly). The KMO measure is an indication of whether the sample is large enough—values above 0.7 are good. Varimax rotation is one way of improving the discrimination between the components that arise from the analysis. Cronbach's alpha is a way of assessing the reliability of a scale that is made up of a number of items: a value in excess of 0.7 is generally regarded as acceptable.

t-test—a paired-sample *t*-test is a way of establishing whether there is a significant difference between two sets of scores from the same group of people. The figure *p* is the probability that an apparent difference between the two sets of scores occurred by chance: as in correlation, a figure less than 0.05 is usually regarded as giving confidence that it is not a coincidence. Effect sizes are also the same as indicated under correlation, 0.1 being generally regarded as small, 0.3 medium and 0.5 large.

Wilcoxon signed-ranks test—this is a non-parametric test that serves the same purpose as a paired-sample *t*-test.

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Author biography

Randall Williams retired in 2008 after a career spent in residential adventure education, including a period as Warden of Outward Bound, Zambia and 30 years as Director of Bowles, East Sussex. On retiring, he embarked on a doctorate and this article summarizes the findings. He was Chair of the English Outdoor Council from 2003 to 2012.

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