Why Schools Fail the Complexity Test and What They Need to Do to Pass It

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May 2019

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This story is about how teachers in a large secondary school in the UK began a journey that enabled them to recognize the advantages of a complex adaptive system. It is a story about how counterintuitive change can sometimes have surprising and positive outcomes. For this school, a new operational model emerged, one that led to ongoing inquiry and the development of incremental systemic change within the complex field of education. One of the important lessons we learned as a school was the mistake of treating an inherently complex situation as if it was merely complicated - something Argyris and Schön called a single loop learning approach to problem solving. Our original intention was to design a process capable of building a genuine partnership with parents, and it was while discussing this that we stumbled upon a major systemic blockage, one we had been working around for the entirety of the school's life.

During the 1990s, we developed a successful software and assessment system that enabled us to track student progress. The challenge was how to share information with parents and students in a meaningful way, one that could advise better strategies for improvement, rapid intervention, and learning support. The number of parents is always far greater than the number of teachers - a math problem and a communications issue - one that secondary schools often resolve by limiting the kind of information sent home to data sheets. Unfortunately, these restrict incoming information by inhibiting necessary learning conversations that might otherwise turn data into information and knowledge into intervention and better practice. For secondary schools, this important home/school feedback loop is invariably partial, mal-formed, assumed, or absent. We believed parents (many of our teachers were parents) wanted to be fully involved in their child's learning, to share the learning burden and see learning as a genuine partnership with school: this meant rejecting the theory that learning is entirely teacher dependent and focussing more on the school as a learning system.

In trying to resolve the issue of parent partnership, we discovered a wicked problem we never realised we had! An awareness grew that the way the school was structured by same-age groups (the grade or 'year' system) was not as straightforward as many of us has assumed. We were unable to develop the kind of partnership learning needed because the groups created organisational problems with numbers and time. On closer examination, it became clear that same-age grouping was not only proving to be a major obstacle to innovation and change, but was the root cause of a host of

recurring behavioural and learning challenges that refused to go away in the school and repeated over time. It was by accident, that in trying to resolve our home/school partnership issues, we suddenly found ourselves travelling along a very different and previously unexplored path, one signposted 'adaptive positive deviance.'

To enhance learning relationships and resolve the parent partnership issue, a more sophisticated approach to collaboration was needed that didn't involve the lumpiness and time limitations of the same-age structure. The breakthrough was the introduction of multi-age tutor groups (homegroups in the USA), a system generically called vertical tutoring (VT) in the UK, New Zealand and Australia. At first sight this may seem more a trivial and innocuous change to the school's pastoral system, and a strategy that could, without due diligence, create a multitude of unwanted and unintended consequences. Nevertheless, we introduced daily twenty minute sessions of homeroom time, and carefully repopulated homeroom groups with students from all grades. This spread conversations between home and school via homeroom tutors across the academic year (different grades have different reporting, learning support, and feedback needs at different times). This meant that the child's homeroom tutor became the learning and information hub, operating at the centre of the child's universe. The academic and pastoral systems became fused rather than separated.

At the time, we didn't realise that we had stumbled upon a system rarity, a leverage point, a design construct where a small change can have a system-wide effect: i.e. the way secondary schools group children is causal to the way the school operates and is managed. As the new tutor groups formed and our communication with parents and students improved, the school culture shifted in a positive direction. The discovery of 'age-grouping' as a leverage point was verified by the significant and unexpected impact the school experienced in a range of issues. These included improvements in participant wellbeing, increased levels of attendance, better pro-school behaviour and improved attitudes to learning; the school seemed a happier place. Parents were delighted and staff felt that the school was now values led.

The incorporation of multi-age homeroom groups (vertical tutoring) created a domino effect across the school, incrementally changing the school's operational form and the management and leadership processes. In trying to solve one problem - the need to improve parent partnership - the school discovered new answers to a host of other persistent problems that the multi-age strategy seemed to resolve.

In essence, we discovered that the way schools employ age-grouping (same-age or multi-age) is a significant determinant of system organisation and participant behaviour. The former acts to keep things the same, and the latter leads to emergence and self-organisation.

For those schools hamstrung by the same-age hypothesis - almost two hundred years in the making and still causing problems - this story must seem highly implausible. Like many discoveries, resolution is often only understood in hindsight and trailalling design changes. Universally, secondary schools remain reliant on the same-age hypothesis, the traditional means that secondary schools use to operate as learning/teaching organisations, and because of its longevity, same-age grouping is widely (if errantly) accepted as a benign system construct. Few choose to question its organisational integrity and this reflects an absence of second loop learning. The message from the growing number of schools (mainly in the UK, Australia and New Zealand) that have transitioned to multi-age organisation, suggests that reformers, institutions and governments have been trying for too long to make the wrong model appear to work better. This has led to the inevitable assumption that teachers are the problem that needs fixing rather than the system which disables them.

Two ideas are clear. Transformational change requires a disturbance in linear thinking sufficient to start a reflexive process, one that can move the school beyond the containment of its same-age structure. The school has to realise that it has a systemic problem. Secondly, for any internal cultural change to occur, only the school can bring about the changes it needs; an open process that involves connecting to more of itself and its community. To understand how we got to this point in time, a trip to the past is needed where the first design assumptions occurred.

A Brief History

During the 1830/1840s, Prussia was deemed the 'go to' place to study a functioning education system. Horace Mann, Secretary to the Massachusetts Board of Education, appalled by the condition of schools, was among the first educational tourists to embark on a European fact-finding tour. He returned convinced that Prussia (the Finland of its day) had the answers needed to build a more effective school system. He wrote, 'In all places where the numbers are sufficiently large to allow it, the children are divided according to age and attainments.' Here is the original leverage point that continues to determine management structures. This had profound implications, effectively

determining the blueprint for school design and operational management to the present day - a 175-year uninterrupted timespan. States and legislatures were able to control curricula, specify teacher training, obtain performance data, and define what might be standardised and easily measured. Mann's design strategy marked the first formulaic 'effect list' or 'what works', one that continues to be universally endorsed by jurisdictions convinced that a system based on grouping by age is tenable, benign, and can be made to work for the common good. So why do so many of the same problems identified by Mann seem to persist today?

In this paper, I will politely suggest:

1) that we need to urgently rethink the relationship between complexity and organisational processes in secondary schools; and
2) that we are wasting our time and resources in trying to make a dominant same-age model work better.

The road travelled is littered with discarded governmental reports, ill-advised financial investments, dried-up funding streams, misguided expert advice, and the failure of reform. Today, in complex western cultures we continue to witness the collateral damage to wellbeing and learning caused by metric-based accountability and the seemingly relentless pace of economic, social and cultural change. We are no nearer to any enlightenment or paradigm shift. Mann's recommendations and the legislation that followed, heralded the near demise of multi-age approaches and set in motion the epistemological and technical-rationalist (factory thinking) model of schooling that continues to this day, one accepted as 'the taken-for-granted form of organisation.'

Mann produced a powerful design construct (a systemic lever) that still determines policies, practices, procedures, protocols and principles today. These dictate how a (large) school functions managerially, hierarchically, relationally and communicationally, determining how staff, students and parents should respond and behave in thought and deed. Parent partnership was never party to Mann's design brief.

As King and Frick (1999) noted, 'With the grandest of ideals, designers often aim towards creating a new school that looks totally different from traditional education, only to find that the resulting system is very similar to a traditional classroom!' It is the problem noted by Pirsig that without a change to rationality, the past simply perpetuates.

If schools are to change, they have to encounter a significant perturbation that leads to critical reflection, and the heightened consciousness needed to unfreeze a mindset forged from a century of inherited controls. Imposed change invariably causes schools to retreat, expel borders, and sometimes fail. This failure has resulted in complex attempts at reform whereby schools have been rounded-up, or persuaded to circle the wagons into charter organisations (US) or multi-academy trusts (UK) all unknowingly intent on maintaining sameness.

Back to School

So, what has complex adaptive theory to do with all of this? Surely, everyone knows that schools are incredibly complex places, beleaguered by a seemingly infinite variety of student demand on resources and serviced by hard-pressed and needlessly criticised teachers, sometimes holding down two jobs to get by. Surely the problem is investment, better leadership, increased accountability, more pro-social programmes, and better training. Well, no! Spending money on a system that has passed its use-by date and is unable to reform itself only complicates things, it doesn't change the system's fundamental form and inherent mindset.

If we look closely at the same-age construct in a secondary school system, it becomes apparent that schools have a strange relationship with complexity. Not only were schools never designed to be complex learning organisations but most spend their time and resources trying desperately hard not to be complex. The feedback loops needed to convey tacit knowledge and information between staff, students, and parents are not only heavily controlled and restricted (our parent partnership problem!) but separated, reduced, broken, or missing. In fact, the critical social and learning feedback loops needed for networking were never part of the original design and attempts made to bolt-these on to the existing same-age structure fail. Close system examination of a secondary school, one that follows the day-to-day experiences of teachers, students and parents, reveals reductionism, mass fragmentation of communications, and assumed information networks. As far as information is concerned a school is systems light; it stifles the feedback loops and interconnectivity needed to produce tacit knowledge, appreciative inquiry, generative thinking and communities of ownership. In their present same-age structural form, schools have what Senge called, an organisational learning disability.

We might legitimately use the word complex to describe the variety of individual demand that students bring to school every day. This value demand is what schools are faced with, what schools are there there to absorb. To cope with such variety requires a complex systemic response: the school's hand-me-down biological reaction to such potentially overwhelming disturbance is to control and reduce value demand; i.e. to build processes that reduce the complexity on its system. It makes no fundamental changes to its internal operational management system and treats the variety of demand as complications to be managed, classified, grouped by type, measured, sorted, sifted and later, batched for delivery. In short, there is a mismatch between the variety of demand on the system and the same-age school's structural capacity to absorb that demand. Unfortunately, treating a complex organisation like a school as being complicated is a big error. So, we have an oddity. A small detour an explanation and a school-based solution!

Of Complexity and Complicatedness

The table below offers an an excellent reference for how to think about simple, complicated, and complex problems.

Table 1
Simple, Complicated and Complex Problems

Following a Recipe	Sending a Rocket to the Moon	Raising a Child
The recipe is essential	Formulae are critical and necessary	Formulae have a limited application
Recipes are tested to assure easy replication	Sending one rocket increases assurance that the next will be OK	Raising one child provides experience but no assurance of success with the next
No particular expertise is required. But cooking expertise increases success rate	High levels of expertise in a variety of fields are necessary for success	Expertise can contribute but is neither necessary nor sufficient to assure success
Recipes produce standardized products	Rockets are similar in critical ways	Every child is unique and must be understood as an individual
The best recipes give good results every time	There is a high degree of certainty of outcome	Uncertainty of outcome remains
Optimistic approach to problem possible	Optimistic approach to problem possible	Optimistic approach to problem possible

Table 1.Glouberman, S. and Zimmerman, B. (2002)

Schools approach the complexity of young people (their social, psychological and cognitive needs) in ways that are complicated rather than complex. Social scientists persuade schools that they belong in the 'complicated' column (above), that there is a body of scientific knowledge (an 'effect list' of 'what works') that, if followed by teachers, would allow all children and schools to perform optimally.

The formulaic and Newtonian management approach of the complicated column involves grouping students by age, approximating ability within a narrow range of subjects and restricting students to the high risk (perceived safety) of same-age friendships. It also believes (this is almost sacrilegious not to believe!) that if every classroom had a great teacher, all school problems would go away. Unfortunately, this prescriptive strategy masks the underpinning ailment; the way structure determines relational behaviour.

This is, after all, what we have always done. I would argue that using this idea has endangered us all by creating a system that privileges the few and prevents social mobility. I would also argue that far from heading towards the complex column, schools are persuaded to resort to the simple menu of the LHS column (the effect- list column), the one that Mann witnessed in Prussia; schooling as a state controlled, non-emergent, non-self-organising, limitational and separational enterprise. This article is not a postmodernist request for social justice. It simply says that schools might be far more effective and children learn more if the psychological needs of process participants were met by an improved design more able to address needs.

The latest iteration of the same-age model encourages teachers to collaborate in a system ill-designed for such an approach. The fact is, as Glouberman and Zimmerman imply, too many damaged 'rockets' fail to reach the launch pad, some never ignite, and others are unable to achieve orbit. The huge effort and costs invested not only fail to match the desired output, but the system has unintended human consequences in terms of deteriorating mental health, loss of participant well-being, and poor recruitment and retention of teachers. These amass further costs beyond the school gates, needed to fix what the same-age system broke, except that this too fails; i.e. instead of addressing the same-age cause we overly rely on and invest in fixes (pro-social programmes), repairs (school psychologists and counsellors on speed-dial) and the need for repeat work (failure demand) that travels far beyond the school gates (including more psychiatric services and prisons).

The challenge, therefore, is to shift schools from the complicated column to the complex column and not assume that our diverse and talented young people share the dulling commonality needed to respond to a one-size fits all strategy. Schools as we know them have passed their organisational use-by date and have failed to evolve into the more complex, divergent, self-organising and emergent forms needed. They have become overly rigid, the inevitable product of their original design specification; this is not the fault of teachers but the consequence of our inability to expose and discard the frailties of the same-age hypothesis as a viable learning and organisational platform. It is a system driven by needless paranoia and a belief that complexity must be somehow controlled before it wreaks havoc. Unfortunately - and paradoxically - the failure to find a means of embracing complexity has created the havoc currently experienced.

Liberating Structure and Complex Change

Many schools in the UK that have adopted a multi-age organisational approach (estimated at 500 and rising) where, for a short part of the day, children are in multi-age groups, Such schools report greater happiness, more supportive learning, significantly less bullying, less need of pro-social programmes, improved wellbeing, higher resilience, and greater collaboration. These schools have adapted and complexified their operational form by redesigning themselves and investing in more sophisticated learning and communications networks. These schools claim to be safer and care more because they are 'complexity dependent'; they grow learning and support networks reliant on trust, distributed leadership, partnership and social collaboration. This produces thick data via open and vibrant feedback loops operating simultaneously (and with minimal controls) at the school's organisational 'edge of chaos'. Such networks have the capacity to hold more information besides being more flexible in solving problems, i.e. they have an emergent capacity. The multi-age school does this by rerouting all information through the tutor, operating at the junction of the school where parents, teachers and students interact to produce and share information. It is this redesign of the communications system that complexifies and enables the school to absorb value demand.

Two theories explain why we should stop treating school systems as though they were complicated. Stafford Beer (2001) talked of POSIWID; i.e. 'the purpose of a system is

what it does.' If the system damages staff well-being, lowers morale, replicates inequality, leads to bullying, caused a deterioration in mental health, sends people to prison in large numbers, makes no impression on social mobility, causes disaffected, insecure and angry young people to deal with their anger management issues in violent ways; if such a system leads to mental harm, is judged by narrow outcomes, fails to respond to reforms, and needs yet more add-ons, fixes and costs to repair our kids, then this is what the system does: its purpose! It has little to do with apportioning blame on 'bad schools' or 'bad teachers' but everything to do with a 'bad system' grown overly complicated over time. It has everything to do with the way the unquestioned, non-emergent, and misunderstood organisational same-age hypothesis causes errant behaviours characteristic of itself.

The second theory comes from Robert Ashby and the law of requisite variety. In simple terms, a system must be sufficiently complex to match the variety of demand it is there to absorb. Schools that operate multi-age organisational processes take a first step towards such complexity. This makes them sufficiently complex to absorb the variety of demand they face. In this way, schools can be compliant with Ashby's law and respond positively to Beer's POSIWID.

Designing a Complex Adaptive School

So, why am I so certain that same-age organisation is a major obstacle to schools, learning, and the betterment of society? There is a simple answer and it is why the Plexus Institute sparked my interest. The narrative from the growing number of secondary schools that have engaged with critical reflection and have subsequently abandoned same-age organisation, contains encouraging themes and principles in line with adaptive positive deviance, the liberation of structure, complex adaptive theory, and the protection of the commons. Further, as a researcher and trainer, I can find no evidence from other disciplines such as child psychology, sociology, cognition, or philosophy that supports staying with the rigidity of the present same-age system.

At the start of this paper, I spoke about a wicked problem that we didn't know we had until we resolved it. That multi-faceted problem, promulgated by same-age organisation, was the system's inability to recognise, access and harvest information from staff, students and parents) and act on that information rapidly to effect better learning and support relationships.
We didn't realise that far from being an open system (how we thought of the school and ourselves), our school was closed, and this closedness determined our system

behaviour and our inability to absorb value demand.

By trying to solve our parent partnership issues in a clever way, effectively pushing the same-age lever in a multi-age direction, we started to resolve other problems we had never intended to resolve. It was in that reflexive moment that we knew that we had stumbled upon a means of building a better management and learning system.

We complexified, creating more tutors (all school employees) and smaller tutor groups. We then re-routed all information through tutors as mentors. This enabled us to recognise the individuality of every child (to 'know' every child) and massively increase learning conversations (feedback and support loops) between participants. The classroom (same-age) remained untouched (for the present) while tutor or homeroom time became multi-aged.

These are some of the practices that marked the start of the multi-age approach.
1. The number of students in the school was divided by the number of rooms. We agreed that the optimal tutor or homeroom group size should be between 18-20 students (preferably never more than four students from any grade or year group).

2. We then decided that that everybody employed by the school should be a tutor. This included ancillary and support staff including the school principal and leadership (admin) team. Each tutor group would have two tutors, at least one of whom had to be a teacher. This ensured every child would be known and supported.

3. Each group was carefully repopulated and balanced with students from all years or grades: tutor time would be 20 minutes each day and would occur before morning break.

4. Finally, no pro-social programmes would be taught in tutor time (if at all).
This time belonged to the tutors and tutees.

The effect of such changes led to an immediate and significant increase in networking processes, dialogics, and individual learning support. 'Care' is effectively redefined. The model meant that tutors acted as conduits of learning, connecting assessment information from a feedback network of teachers, students, and parents.

As an organisation, the school was then able to:

a) Absorb a significant increase in communications and networking;

b) Reconnect feedback loops between staff, students, and parents;

c) Intervene quickly and more effectively at the value demand stage.

Everyone in the school, including parents and students held useful learning information (nodes or stocks in systemic terminology) while tutors became the network hubs, the synaptic links in the school best placed to handle information. This vast increase in communication meant that the tacit knowledge could be better shared and flow freely via mentoring, enabling organisational and individual learning.

As more schools adopted these practices, a set of design principles (set out below) grew from trialling and modification to achieve a practical working model.

1) All white-collar employees are tutors (and some blue) regardless of status, including managers, school leaders, non-teaching staff, clerical staff, librarians, support staff, counsellors, and technicians. This ensures as far as possible two tutors/mentors (one lead and one co-tutor) per group, one of whom is a teacher. The considerable benefits of such a practice are legion. Senior managers are involved in the value work and have direct feedback regarding operational matters and can better identify staff, student and parent needs. Hierarchy becomes more flexible and less controlling as leadership is distributed to the edge and to all participants. New hierarchies emerge and dissipate to solve problems at source as needed.

2) Every student is known and recognised as a unique individual and fully supported, even if one tutor leaves. Parents, students and staff have direct access to tutors as learning conduits and vice versa. While the hierarchical school structure is still evident, responsibility for support and learning shifts to all agents (staff, students, and parents): leadership is distributed and enabled (not empowered) at the organisational edge where tacit knowledge is shared, harvested and interventions made. This reduces failure demand and enables the school to absorb complexity and intervene rapidly. The organisation can learn and self-organise.

3) Because of their unique position, tutors act as 'leaders of learning' (support and information hubs) and the school is redesigned around the centrality of the tutor, parent and child team. In short, the school is organised from the value needs at the base rather than the data needs at the top. The learning relationships, confidence and resilience that grow in tutor time transfer to the classroom to facilitate teaching and learning. Because everyone is collaboratively involved in the learning process, the system and vision are understood by all. Responsibility is shared, and full parent and student partnership feedback loops reinstated.

4) All students are trained and supported to be leaders and mentors as they progress through the school; it is the development of multiple learning support and mentoring relationships (feedback loops) that makes the school complex (information rich) rather than separational and complicated. Students are trusted to take on responsibility for others. Empathy and resilience are designed in and bullying designed out, virtually negating the need for pro-social programmes.

5) The school adopts a house or college system (schools within schools—the ecological nested system advocated by Bronfenbrenner, 1992 and others). This nested system starts with multi-age friendships in tutor time and expands from there.

6) Deep learning conversations (DLCs) involving tutors, students and parents are introduced at all critical learning times serviced by rich information and thick data from the school. Assessment for learning (summative and formative) is reviewed by this group, and a commitment made regarding agreed strategies for improvement. This is the hub (information node) that provides an emergent strategy, builds a firm support base, and enables flow - the way information moves and is interpreted and activated as knowledge.

7) The DLC provides a summative assessment of learning and so knits with formative classroom assessment. Assessment for learning (AfL) incorporates written and agreed strategies for achievement driven by input from staff, students and parents. Agential communication is facilitated to ensure a high organisational learning capability; this recursive process contains within it the emergent properties of self-organisation and innovation.

8) Tutors do not teach PSHE (personal, social and health ed.) or other pro-social programmes. Tutor time is the tutors' time. Resilience, empathy, and social networking via citizenship are designed into the relationships of VT and no longer added-on, saving time and costs; i.e. supportive and empathetic relationships, resilience and tolerance of diversity are integral to the systemic design, not bolted on.

9) The significant redistribution of leadership to all actors offers the prospect for systemic change by creating a mix of permanent and flexible hierarchies. Leadership and followership become interchangeable. The school leader must undoubtedly hold her ground when mistakes inevitably occur and act as a servant-leader and torch-bearer of values at other times.

10) To make the system work, the school must review the information it uses to bind the system operators, to ensure connectivity and co-evolution. In a values-led system, grades are only part of the whole picture.

On joining such a school, a child is absorbed into a complex network that involves older students, who act as leaders and mentors, all guided by tutors - the first stage of the nested system. These are people that the child sees every day, who provide support, mentoring and friendship. There is no longer a need to worry about finding friends or being bullied at school. Each child has the group and individual support needed from which to venture out and grow personal resilience. All students are offered (and readily accept) leadership opportunities for younger ones which means all are trusted, accept responsibility and have a social sense of what it is to be truly 'cool'. No-one is isolated; like "Cheers!" everyone knows your name. The school becomes socially collaborative to support learning and achieve psychological coherence. The school/home partnership is re-established, serviced by conversations, not simply online access to lists of grades, but comments about learning behaviours and strategies for improvement and support. Once the multi-age change lever is activated, it has a domino effect.

The best approach is not to complicate or control it, but to let it run its course until it simplifies into patterns in the way complexity always does. Twenty years on, the multi-age approach continues to develop as a collaborative system and adheres to many of the basic premises of a learning organisation. Whether or not these schools can set up camp on the lower slopes of paradigm change will be a matter of courage and ethical conviction.

To transform something is to change its fundamental external form or inner nature. . . In the world of nature, a caterpillar is transformed into a butterfly; its DNA remains unchanged, but its form and properties are fundamentally different. A butterfly is not a caterpillar with wings strapped on its back.

Nevis, Lancourt & Vassallo (1996)

We cannot make schools by bolting on parts to a flawed hypothesis. In the end, it is for schools to decide whether or not they should shed their chrysalis and grow into the butterflies we need them to be. When they do, they will realise that complexity and evolution make sense.

This paper makes clear the need for schools to be managed as complex systems. In my experience, the adoption of a multi-aged organizational approach for part of the day has the potential to create positive outcomes not only for school practitioners and students but for communities and the common good. My hope is that through this paper schools that have adopted multi-age organisational strategies will continue to share their experiences, and that other schools will open themselves to organisational learning and change.

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Stafford Beer (2001). Address to University of Valladolid, Spain. (Beer noted how complex systems and conventional ideas on management don't accord. From cybernetics, POSIWID provides a helpful aid for systemic understanding. Beer described Ashby's Law (above) as 'variety absorbs variety.