The Passion to Learn

An inquiry into autodidactism

Edited by
Joan Solomon

RoutledgeFalmer
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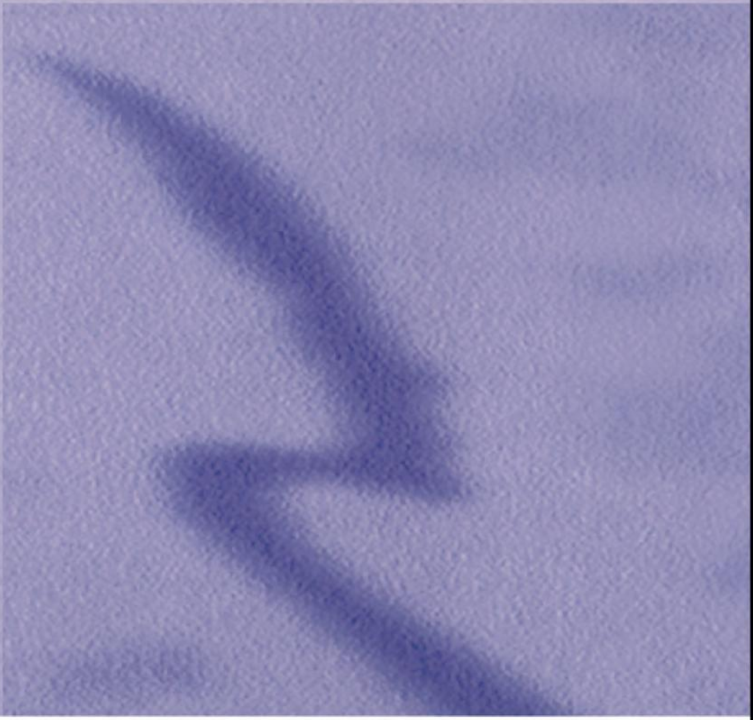

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Contributors

Joan Solomon During more than 25 years teaching Physics and the Social relations of Science (STS) in a variety of secondary schools she became deeply interested in the learning of students of all abilities. After moving to Oxford University she taught student teachers and delivered professional in-service education. She carried out several research projects for the government on the new vocational courses once again making detailed observations of the students. More recently she has become Visiting Professor at the Open University and the University of Plymouth. She has run a small 'hands-on' Interactive Science Centre for research on primary pupils, taught adult classes, and carried out research on learning through practical work, as well as writing widely on students' learning, publishing four substantial books and many articles in international journals.

Margaret Boden is Research Professor of Cognitive Science at the University of Sussex. She is an elected Fellow of the British Academy, and of the American Association for Artificial Intelligence (and its British and European equivalents). Her work is highly interdisciplinary, since she holds degrees in medical sciences, philosophy, and psychology. Among her books are 'The Creative Mind' and 'Dimensions of Creativity' (ed.) which have been translated into 17 languages, and she has given lectures and media-interviews around the world. She has two children and one grandchild, and lives in Brighton.

Helen Brooke lived and worked in France for 13 years, teaching Health Education to varied groups. Her own children grew up to be bilingual there, and her interest in different ways of learning originates from this time. On returning to Great Britain she worked as research assistant at the small Interactive Science Centre run by Professor Joan Solomon. Helen is currently team leader of a language resource base for pupils with speech and language difficulties attached to a mainstream secondary school. She is working towards a PhD based on her research at the science centre, which focuses on the extent to which this environment allows young people with severe learning difficulties to be autonomous learners.

Paul Howard is an education and training consultant and a partner in Dreyfus Training & Development. Having formerly worked as a youth and community worker, teacher, lecturer, he was for eleven years the Headteacher of the behaviour Support Service in the London Borough of Newham, where he was at the forefront of that Authority's Inclusive Education strategy. His continuing commitment to social inclusion is reinforced by an interest in Multiple Intelligences theory as a basis for placing learning differences rather than learning difficulties at the centre of education thinking and practice.

Robin Hodgkin has been an eminent mountaineer climbing in Skye and the Alps as well as an active Quaker and spent many years teaching in Kenya and the Sudan. On his return to England he became a Tutor in Geographical Education at the Department of Educational Studies at Oxford University. He read constantly into many branches of philosophy and about the various paths of creativity. He has published many articles such as *The Seriousness of Play,* and two notable books on similar themes *Born Curious. New perspectives in Educational Theory* (1976) and *Playing and Exploring* (1985).

Vivian Leyser da Rosa is a lecturer in Human Genetics at Federal University of Santa Catarina (Florianópolis, SC). Teaching and researching in her field for over 15 years, she became increasingly involved with the education of future health sciences professionals, including medical students. The training of such future Brazilian professionals in the field of Genetics, given its present ethical, social and cultural implications and the need of professionals to act as mediators between science and the public, became a theme for her doctoral thesis, part of which she developed with Joan Solomon at Oxford University. Besides teaching Human Genetics, she organises seminars in Genetics and Ethics and provides genetic counselling services.

Richard Edwards is Professor of Education at the University of Stirling, Scotland. Prior to this he worked in Adult Education in Kent and London and at the Open University, UK. His interest in self-directed learning derives from his own experience of learning philosophy as an undergraduate and postgraduate, as his attendance at lectures and seminars was minimal. Books and friends have been the source of much of his learning in both personal and professional contexts. It is not surprising therefore that he has researched and written extensively on adult education and lifelong learning.

Stephen Lunn is a Research Fellow at the Open University, specialising in learning and pedagogy in primary and secondary education. Subject emphases are science and design technology; particular foci are the cross-curricular themes of creative problem-solving and sustainability. The theoretical perspective is broadly socio-cultural, with concerns for the relationships between models of learning, knowledge, and pedagogy; and relationships between individuals and communities of practice. His interest in autodidactism is centred on the latter, particularly where the communities are more or less remote from the learning individual.

John Ziman is Emeritus Professor of Physics at the University of Bristol and a Fellow of the Royal Society. During his career as a theoretical physicist he became interested in the social and personal aspects of science, on which he has written a number of books, including Public Knowledge (1968), Reliable Knowledge (1978) and Real Science (2000). He might be tempted to describe himself as an autodidact in the sociology and philosophy of science, except that all scientists and scholars have to go on teaching themselves new things all their lives.

Paul Caro is a former 'Directeur de Recherche' at CNRS. He is an inorganic chemist specialising in lanthanides. He became involved by chance (1980) in science popularisation in the form of newspaper articles, radio and TV broadcasts on a variety of topics across the scientific world. Appointed Délégué aux Affaires Scientifiques of la Cité des Sciences et de l'Industrie in Paris in 1989 he became more involved in the ways and means of public understanding of science and scientific literacy both from the practical and theoretical point of views, especially in the Science Museum framework. Besides articles in specialised literature he has published five books on science popularisation and the science-society relationship and was also involved in European programmes assessing the diffusion of scientific knowledge especially through education and pedagogical experiments.

Tim Hunkin trained as an engineer, but then became a cartoonist (drawing a strip for the *Observer* called 'The Rudiments for Wisdom' for 15 years). His next career was in television (writing and presenting three series called 'The Secret Life of Machines' for Channel 4). He now works mainly for museums, building interactive exhibits and curating and designing exhibitions (most recently the Visitor Centre for the Eden Project in Cornwall).

Anita Rampal is Professor of Elementary and Social Education at Delhi University (India). Trained initially as a Physicist, her involvement as a voluntary resource person for the Hoshangabad Science Teaching Programme caused her to change track. The engagement with school science, especially for the disadvantaged majority, who struggled with irrelevant and poor educational programmes in dilapidated rural schools gradually grew into a lifelong commitment. She has co-authored books such as *Numeracy Counts* (1998), the *Public Report on Basic Education* (1999) and others written in Hindi, in addition to several other research articles and reports.

Eileen Scanlon has worked with science learners at the Open University, UK for the past 28 years. Before this she worked as a schoolteacher with secondary school pupils, teaching general science, physics and mathematics. At the OU she has been involved with design and evaluation of a wide range of science courses and is now a Professor of educational technology. She is particularly interested in the uses of information technology in education and directs the Computers and Learning Research Group working on a range of projects including remote access to laboratory work. Her publications about science teaching include Open Science: the distance teaching and open learning of science subjects. Recently her research has included work on communicating science.

Albert Paulsen has for the last 25 years been a senior lecturer at the University of Roskilde in Denmark, which is recognised for its alternative studies based on problem centred, participatory project work. His main research interests are in learning science through practical work and in Science for Citizenship. Besides being a teacher and supervisor in Physics and Science Education at the university, he has participated in and carried out several research projects in a national and European context as well as been involved in national evaluation and curriculumm work. During the years he has edited, contributed to and been the author of several books on science education and teaching material. Recently he has retired from his post and now holds a part-time senior affiliation to the university.

Jack Diamond was born and brought up in a poor part of Leeds, where he attended Grammar School and later trained to be a chartered accountant. The lack of opportunity for young people from poor backgrounds influenced him to join the Labour Party. He took a practical approach to learning about politics serving as a governor of a hospital and of a school in the East End of London, and using his business training to probe their management. He entered Parliament in 1945 and was First Secretary to the Treasury from 1962–68. He was given a life peerage and served in the House of Lords as Leader of the new Social Democratic Party and Chairman of many committees. In his early nineties he embarked on an extensive reading programme to read and explore religious literature of the Abrahamic tradition in the original languages.

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Introduction

Joan Solomon

As the title suggests, this book is an inquiry into an area which is little charted. There are fifteen central chapters written by those who know something valuable about autodidacts. Their contributions are first-hand stories about children or adults in different but autonomous learning circumstances. To collate these chapters and relate them to what is known about learning, the book needed an opening chapter to present an overview of the learning theories that might be applicable, so that was added. A handyman attempt was made to compress the multitude of words written on the subject into one readable and useful chunk.

Then it needed at least two more chapters at the end to pursue and round off the investigation, however incomplete. One was to collect and draw attention to any common features which were emerging under the very different circumstances of the fifteen central chapters. These were drawn out from the process of reading and rereading the contributions of my colleagues, who had little or no communication with each other. Then what was thought to be a final chapter was written from the different perspective of some important and controversial contemporary social theories. Like most finalities this one also lost its place and was shunted backwards when the publisher and reviewers suggested that yet another chapter was needed. This became an epilogue where I started the process of finding out how insights into the nature of autodidactism might be used within the many worlds of education. It could only be very incomplete at this stage.

This study and book forms a part of the programme of The Epistemology Group. All their work has addressed the theme of the evolution of knowledge and invention —with publications on *Technological Invention as an Evolutionary Process* (ed. Ziman 2000) and *The Evolution of Cultural Entities* (ed. Wheeler, Ziman and Boden in press). They funded the original seminar for the present project, 'Autodidactism and Creativity' which was held jointly by the Royal Society of Arts and the Open University, and from which this book drew for many of its contributors. For all of this it is a pleasure to express my gratitude to the Epistemology Group, the Open University, and to the contributors who made the work possible. After the opening seminar I badgered some of my other colleagues to add a few more contributions for which I am equally grateful. I also need to thank numerous friends for useful comments and informal information.

Finally my thanks and love go to John Ziman, who encouraged me in this excursion into a new field of knowledge by judicious administrations of acclaim and the reverse, as appropriate, during the writing of this book.

May 2002

Chapter 1

Theories of learning and the range of autodidactism

Joan Solomon

Who is an autodidact?

From its etymology, an autodidact seems to be one who teaches her or himself. Indeed a Greek friend of mine, on learning of my interest, said 'Why use a Greek word? Why not "self-taught"?'

But at once there is a problem. None of us could possibly be anywhere near to being completely self-taught. From the moment our mothers put a spoonful of food to our lips so that we could suck at the spoon's edge, we were being taught, although it must be added that quite a few babies spit out the food and seize the spoon themselves! Is that autodidactism? Every time someone speaks, or points out a bird doing something strange on the lawn, or reconfigures the computer slowly enough for us to follow—if we want to, we are being taught. Perhaps we might say, in retrospect, that we were *allowing ourselves* to be taught. That puts autodidacts in a new light. Why do such people, and indeed it may be nearly all of us, sometimes react in such a difficult 'ornery' way to being taught? This is close to some of the central problems that this book will address in trying to describe the range of autodidacts. These do not occur because autodidacts don't want to learn. They do.

Not all children enjoy school, but we are all 'born curious', as Hodgkin wrote (1976). This wonderful quality, curiosity about *new* things, is so well established by experiment that it is used to study small babies' recollections of music even from the time they were still in the womb, understanding of gravity, or the cadences of their mother's voice. Even babes just a few days old will turn to look at something new and ignore effects that are old and well-known. This is the beginning of learning from experience, which is concerned with delight as well as knowledge and is the background to almost all the accounts in this book.

So 'self-taught' will not quite do as a complete description of the autodidact. We need a word to describe a range of people who prefer to teach themselves or to pick up knowledge from non-teaching situations, in one way or another. The state of being such a person is our title word—autodidactism. We can also tap into neighbouring and more familiar words, such as 'autonomous', which bring with them a whiff of independence if not rebellion. They may get angry when someone tries to teach them instead of letting them find out for themselves. It is a familiar human reaction. All two-year-olds go through this process intensively, we call it 'the tantrums' and it shows a perfectly healthy development of independence. Supporting comment comes from Howard Gardner. He wrote, from the results of his study Creators of the Modern World (1994), that he had found some psychological features common to all these very autonomous people. Not only were they energetic and demanding, but they also retained some of the features of childhood such as going on asking questions and ignoring the conventions, and were themselves fascinated by the exuberant, inquisitive and emotional traits of children.

Most of us have some tendencies towards autodidactism, but that does not mean that we are great creative geniuses (see Chapter 2). At one time or another we all want the freedom to choose. The wish of autodidacts *not* to be taught in certain ways is coupled with a great wish to learn for and by themselves. The awkwardness of these two conflicting drives can sometimes cause trouble for them at school, but may be rewarded in later life by the achievement of original outcomes and fluent personal ways of learning. Those who display these features span a great range of people. We may all have felt, from time to time, their kind of anger at being over-instructed, and their kind of exhilaration when finding out something new for themselves. Autodidacts also come, as we shall see, in a range of emotive and cognitive colours.

People sometimes think that in the days before schools and plentiful books everyone was, perforce, an autodidact. However, learning without a teacher is not necessarily the same as teaching oneself in solitude. There are many other possibilities. One is that a bank of knowledge is picked up by physical imitation. Young predators like fox and lion cubs learn to use their bodies more skilfully for hunting through play. Arthur Koestler (1966) in his book about creativity called this 'ludic learning', although that may well be nearer to sports training than to how autonomous learners cherish new ideas. Apprenticeship for the learning of practical skills can take place through a method of authoritative imposition, which the autonomous amongst us might find insupportable. But it could also take place in a more acceptable way, where apprentices pick up what to do by unpressured imitation. I knew one autodidact who had regularly truanted from secondary school, was unhappy at university, and only started enjoying learning in a research laboratory. Here, she told me, you were expected to pick up skills in a relaxed 'hands-off' way as a part of an established group. We shall also see how this method may be applied to training in a modern industrial workshop (Richard Edwards in Chapter 7).

If what we learn comes only through our bodies then the acquired knowledge may well continue to reside permanently *in our bodies* in a very local sense (see Polanyi's [1958] discussion of such 'in-dwelling' knowledge quoted in Chapter 5). Knowledge so acquired may be essential for instinctive life-saving, and other primitive reactions over which we have little control. Swimming and judging by eye as carpenters do, and other more advanced practical skills are also largely learnt by this ancient method. However we humans learn a great deal more by our gift of speech with others, and our internal reflection about what we do, and once this happens in tandem with actions and skills that our hands have already learnt, it becomes powerful for all kinds of learning.

The start of human learning

During the 1920s Wolfgang Köhler (1925) carried out some famous experiments with chimpanzees to find out if and how they could teach themselves to solve problems. In every case a banana or other fruit was placed out of reach, and various lengths of stick and rope, and sometimes boxes, were supplied. The apes seemed to have different degrees of persistence, and different rates of success just as humans have. Köhler was able to show that the apes, some more quickly than others, were able to make simple implements from ropes and one or two sticks, or from two boxes stacked on top of each other, and use them to reach the objective. One of his interesting conclusions was that once the solution was 'seen', the two actions required to reach the fruit were done sequentially without pause. It is as though the ape has constructed an image of the complete solution in his mind, and then simply carried out the required actions. They seemed to learn from their own imaginative efforts. Sometimes they also learnt by imitation but they never tried to instruct each other (1925:193). Köhler was quite clear about this. Autodidactism might be a very early contribution to learning.

Very soon after news of these investigations had reached the Soviet Union, one of the colleagues of Lev Vygotsky, the famous cognitive psychologist, started some similar research in which Köhler-like problems were set to groups of four- and five-year-old children. Vygotsky and Alexander watched this with great interest and were struck not by the similarity but by the contrast with the apes' behaviour. They commented on the 'planful' character of the speech which accompanied the children's action and concluded that:

> Children solve practical tasks with the help of their speech, as well as their hands and their eyes. This unity of perception, speech, and action, which ultimately produces internalisation of the visual field, constitutes the central subject matter for any analysis of the uniquely human forms of behaviour.
>
> (Vygotsky and Alexander 1930)

This 'internalisation of the visual field' is richer than what the apes may have achieved, but similar. Then talk helps it to become socially shared, and this is also fundamental to making sense of learning. Vygotsky's internalisation of the visual field is similar to Hodgkin's 'conceptual space', an idea which turns up at several points in this book, especially in Chapter 5 which is about two boys playing a new building game with wet sand on a slightly dangerous beach. Like Köhler's apes, Vygotsky's children had to imagine their proposed procedure before carrying out the actions. Out of this prepared space came their planning. In some respects this was like the babbling talk of toddlers as they face up to a new game which later 'turns inward', in Vygotsky's words, to become the basis of silent adult thinking.

If we watch two-year-olds we can often catch them talking out aloud, even if no one else is there, as they prepare to do something interesting with their toys. (And some of us adults still talk aloud to ourselves when no one else is around!). So reflecting when alone on some problem, which might have seemed to be the very prototype of isolated behaviour, can become a kind of internal theatre for the re-enactment of play or problem-solving in the playhouse of our minds. There it draws on earlier social learning situations and becomes quite similar to them. Learning by reflection may take place alone or in a group, sometimes it is intentionally taught and learnt, sometimes it is picked up by silent imitation. Often it is almost impossible to distinguish the one from the other.

Tales of autodidacts

Peter was about 15 when the following event took place. He was a very intelligent and confident boy, taller than average, and he slouched slightly in a casual way. One day after teaching about the transformation of energy I had set the school's model steam engine going. The solid fuel pellets burnt, the water boiled and hissed out of places where the fit of the pistons in the cylinders was not too good. The piston rods punched in and out and the flywheel spun so fast as to be reduced to a blur. That and the noise and the smell was very exciting and most of the pupils pushed eagerly round the engine and shouted comments to each other. Not so Peter. With his hands in his pockets he drew away from the commotion and commented to me that he had always thought about engines and that they only worked because there was a difference of conditions. Either it was hotter inside than out, or there was less pressure outside than in, and that made it work. But, he said, as it worked it seemed like this difference got less, so that it gradually stopped working. I was amazed! This, for any reader who does not know, is a home-made version of the famous second law of thermodynamics, which seemed to have been worked out by Peter on his own.

You need to know two more things about Peter. First, he frequently truanted from school. I had not realised this until a staff meeting was called to debate 'What shall we do about Peter?' and as I could not remember him missing physics lessons, I put it to him soon after the steam engine episode. I said something like 'What is this I hear about you playing truant?', to which he answered 'You don't need to worry Miss, I'm always here for physics lessons on Tuesdays and Thursdays'. We may deduce from this that Peter's truanting was quite deliberate, allowing him to learn only what and when he wanted to. There were other subjects that he did not want to learn, or some types of teacher instruction that he did not like.

The last thing to tell you is that Peter was killed soon after this. He and his friends had stolen a car and in the resulting police chase the car went out of control and the group were all injured or died. Peter did not just dislike being taught at school, he also quite enjoyed breaking regulations of other kinds. (I am *not* suggesting that other autodidacts are equally 'defiant' as Margaret Boden describes them in Chapter 2, but there *might* be some kind of connection in some cases, which we shall explore at the end of this book.)

The next story is about Gillian. At the time I first met her she was about 16, although to me she looked no more than nine or ten because she had Down's syndrome. She did not talk at all during her visit, but she did seem to understand speech and probably could use words and a few simple signs in Makadon—a simplified sign language for those with learning difficulties—that she had been taught at the special school she attended. (I should add that when I saw her the following year she had learnt to read very simple work-cards, and could talk more. She also appeared to have a boyfriend from the college which she attended, to whom she called loudly across the room whenever she wanted to show him what she had done.)

On both occasions Gillian was visiting a simple Interactive Science Centre where I and my colleague Helen Brooke (see Chapter 3) had set up some simple hands-on exhibits. In the first case her teacher was with the class and I was just watching and video recording what happened. The teacher tried hard to draw Gillian's attention to a skeleton which was lying on a table with a deflated balloon in its mouth. With her arm round Gillian's shoulders the teacher talked trying to explain how the skeleton was breathing by pushing the plastic diaphragm in and out. She talked and taught, trying to get Gillian to take part, and to blow up the balloon, but Gillian was clearly set on escape. By ducking out of reach she finally got free and arrived at the electricity table. Here she saw two wires, which she seemed to know needed to be joined together. She also seemed to know that this might have something to do with turning on the light; but she still had some thinking to do and confidence to gain. She took the wires, one in each hand, and approached them together very hesitantly. Then she looked up at the lamp. Was she wondering whether you had to touch the lamp with the wires to make it light up? Very slowly the wires approached both each other and also the lamp. In the end I could not tell if the wires made direct contact, or if they completed the circuit through the brass housing of the lamp. But it did light up, to Gillian's great pleasure.

It was Gillian's body language as she tried to make her escape from the teacher's instruction which is my abiding memory from this episode. She seemed to have just one thing in common with the gifted Peter—neither of them liked being taught. Later we found other Down's syndrome youngsters who turned their heads and looked obstinately away while their teacher was talking, only to start work again once the teacher had gone. One might guess that the outing to the Interactive Centre was understood as a challenge to find out for themselves—that was indeed what the organiser had said to them when they arrived. It was an opportunity they did not want to lose. Another possible explanation is that the speed of their thinking was so much slower than the speech of their teachers, that it made understanding more difficult.

Elaboration of theories

Educational research, whether empirical or theoretical, has been very busy during the last fifty years. Piaget (1972) had written that 'The attribute of intelligence is not to contemplate but to transform'. The prototypical Greek thinker, with head in hand, was now definitely out of date, but Piaget was using the verb 'to transform' in his own technical sense, as the reversal of perceived operations in the theatre of the mind. Similarly the 'conservation' of properties which was fundamental to his whole stage development theory of genetic epistemology also required mental transformations. Despite his important contribution to educational theory Piaget never did see teaching as a real contribution to the development of learning. On one occasion he claimed trenchantly, in the preface to a book by colleagues, *'bits of learning are not development'* (Inhelder, Sinclair and Bovet 1974). Never a very tactful man!

For Piaget learning was an increasingly logical process that we grow into by an internal maturation. The autonomous striving to learn could find no place in this predetermined scheme. Vygotsky emphasised the two-way nature of the teaching/learning process. It seems that he thought of all learners as taking an active part in the process, not accepting taught ideas in the passive way that had previously been assumed. He called this autonomous process of reflection and change 'elaboration'. 'Pedagogy has usually operated on the supposition that children are *receivers* of instruction and not, as they certainly are, *elaborators* of the contents presented to them' (Vygotsky 1978).

This might have been a focal moment in the understanding of autonomous learning, but, sadly, it was not. Neither Vygotsky nor others who used the word tried to pin down what they meant by the elaboration of instruction. No doubt this frustrating omission was partly due to the difficulty in communication between the Soviet Union and America during Vygotsky's short lifetime, or to a contemporary concentration on changing the curriculum in the USA (a common reaction to any or all educational problems). So when a new theory of meaningful learning did arrive (Ausubel 1963, *et al.* 1968) it received comparatively little attention, even though it presented the fertile idea of a connected structure of knowledge in the mind to which, under favourable conditions, new knowledge could be attached. However an aspect of Ausubel's theory known as 'concept mapping' (Novak and Gowan 1984), in which the pupils explore their own learning by drawing out on paper how they see the connections between the concepts they have been taught, has achieved permanent and widespread use. It may also have been the first classroom method which could be said to be based on pupil autonomy and, when it has been used by the pupils as their own research rather than as a method of yet more teaching, it has been very promising. (In Chapter 17 of this book we describe complexity theory, which has some resemblance to Ausubel's theory and can be used to think about the autonomous elaboration of learning in quite a new way.)

Research into student learning

In 1976 two landmark papers were published by a pair of Swedish researchers, Ference Marten and Roger Säljö. These were attempts 'to identify different levels of processing of information' used by Swedish university students who had been given substantial passages to read about economics. At one level, called 'surface learning' the students focused on memorising what they expected to have to face later as test questions. There was no elaboration and, unsurprisingly, they did not much enjoy this pressure to learn.

> 'Well I just concentrated on trying to remember as much as possible.'
>
> 'I'd sort of memorised everything I'd read.… No, not everything, but more or less.'
>
> 'It would have been more interesting if I'd known that I wasn't going to have a test on it…instead of all the time trying to think now I must remember this, and now I must remember that.'
>
> (Marten and Säljö 1976)

But the deeper kind of learning was quite different. Students who learnt in this way were concerned about the meaning of the passage and often looked to see how the new ideas linked with ones already existing in their minds.

> 'I tried to look for…the principal ideas'…
>
> 'and what you think about then, well it's you know—"what was the point of the article?"'
>
> 'I thought about how he had built up the whole thing.'
>
> (Marten and Säljö 1976)

This last comment, and others in the research, suggests that these deep learners might be thinking about the knowledge as a connected structure, as Ausubel had done.

Similar results were reported from research carried out in England by Noel Entwistle and Judith Ramsden (1983) and from Australia by John Biggs (1980). Biggs had become impressed by the evidence that some months after any teaching/learning process the student's understanding could be found to have gone either up or down. Going down could be explained easily enough by forgetting, but what could increased understanding, improvement without any teaching, mean? Was this autodidacticism?

> The individual then…thinks it over, sees some personal relevance he or she had not noticed before, relates this new material to previous material—and so the stored version is now at a higher level than at encoding. *Studying is to elaboration as teaching is to encoding.*
>
> (Biggs 1980)

This research into what students said about their own methods of learning showed, unsurprisingly, that being pressured into learning for examinations was not at all well liked: but contributing to the learning for themselves, 'elaborating' as Vygotsky had called it, was both more effective and somehow self organising. This last finding by Biggs—the autonomous reorganisation of learning—suggested that either students keep on reflecting about what they have learnt, or that some neural activity had the power to move, change, or possibly link up the learning in their minds. This exciting new approach will be discussed in Chapter 17.

John Biggs had at least one more piece of information which might connect the way students learn to the concept of autodidactism. Using his large database from the thousands of university students who had filled in the questionnaire about their characteristic methods of study he was able to show which statistical variables were most strongly associated with a 'deep' approach to learning. For our purposes, it is only marginally interesting to note that intelligence as measured by IQ tests was a more significant characteristic of deep learners than of surface learners; whether as a cause or an effect, or both, we cannot know. However there was another factor showing an even stronger statistical correlation with the factors that identified deep learning. This was having an internal locus of control (wanting to be in control of one's own activities). It is perhaps the strongest evidence yet that our investigation into learning is on the track of autodidacts.

Constructivism and conceptual change

At about the same time as John Biggs' work, a lot of research was going on into school students' own naive ideas about natural phenomena. This was called constructivism in educational circles (the term is differently used in sociology). It is included here because the method was based on experiential learning, which could be called the lived learning of people who, for example, note the appearance of rainbows with curiosity as well as aesthetic delight. In science education this worked both with and against the autonomous ideas of pupils, and it is now possible to look back on this research, which was so plentiful during the 1980s and 1990s, in the light of this difficult mixture of educational goals.

The contributions to constructivist research by Rosalind Driver, who is so sorely missed in the educational world, was mostly about thinking in the classroom which used stored ideas from experiential learning to answer questions about science (1978, 1983). At this time my own research was on the social influences on how pupils constructed explanations for what they observed in the world, and then discussed with others (Solomon 1987, 1991). There were also some contributions from von Glasersfeld, which were different again, although on the same general topic, being severely internalist and solipsistic (1989). (This differentiation between the social and the personal aspects of learning will arise again in the discussion of sociological controversies in Chapter 17.)

The educational world, with its interest in assessment, is always very focused on conceptual change—how to *change* students' ideas into the scientifically correct ones. First Driver’s team of gifted teachers set about eliciting the pupils’ own ideas about phemomena in a classroom situation. Sometimes they had the pupils write diaries about their ideas, and from these we can often see autodidacts of different kinds not only putting forward their ideas but subsequently defending them very persistently. Any autodidacts worth their salt would stick to their own notions as long as possible. The constructivist classroom process could be quite uncomfortable for both such pupils and their teachers. Explaining your own ideas to others might be satisfying, but being forced to change at the teachers’ behest in front of the whole class could well be humiliating. Some of the students fought to show that the teacher’s arguments and demonstrations did *not* refute their idea, even if they seemed to do so. In my own experience this method was, at the very least, difficult to manage in the classroom. By the 1990s, careful longitudinal evaluation had shown that this way of teaching, which some autodidacts might have enjoyed in parts, was not any more effective for learning science than the more usual one which was administered to the control group (Johnston 1990).

There was another more complicated problem that was often ignored. If, as Johnston reported, the pupils were highly motivated by sharing their own ideas with others rather than being taught by a teacher, why didn’t this increase their interest in science and so their learning achievement? This seemingly simple question has two *negative* answers. In the first place the constructivist way of teaching, as we have seen, does *not* improve achievement. Second, in a surprisingly large number of other studies of motivation the correlation between interest and achievement has always been low, variable, and sometimes *even negative* (Gardener 1975). There was a serious anomaly here which seemed to run contrary to common sense (see page 194 Chapter 16).

Educational psychologists began to wonder if these apparently rogue results were due to student anxiety being aggravated during tests. They introduced more supportive teaching, only to find that, in some cases, this actually decreased achievement further still (Weinart and Helmke 1987). Very curious! Eventually some further results from Helmke (1988), Valås and Søvik (1993) and others suggested that it was the teaching process itself which was the cause of the problem. If teaching produces something like anxiety or demotivation which reduces learning efficiency, there are at least two quite different ways we can deal with the problem.

> In the first place we can try and change the students to fit the instructional provisions. That means, that an attempt must be made to decrease their fear of failure and increase their self-efficacy, task orientation and intrinsic orientation. However we know from experience that changing personality traits is notoriously difficult… An alternative solution is to modify the level and type of instruction.
>
> (Boekaerts 1994:6)

So the research project began to investigate what happened when 'the density of instructional input' was reduced. Like the special needs student Gillian, mentioned earlier, students *did* learn better without too much instruction. When such research was backed up by interviews with the students there was not just verbal corroboration but also identification of particular teachers who were seen as having had oppressive 'controlling tactics'. For the researchers this pinpointed the very lessons where controlling words like 'should' and 'ought' were most frequently used. This seemed to show that intensive teaching was simply counterproductive —more teaching but less learning. These are vital findings for the education of all our students, not just for those we identify, always rather uncertainly, as some kind of autodidact.

The wish of students to be autonomous also arises with respect to environmental action. In a review article about issues in environmental education Peter Posch (1993) told the story of a Swedish school where students had taken the initiative in treating a local lake with lime in order to neutralise its acidified water. When the treatment was found to be successful, several other local teachers were inspired by it and tried to get their students to do the same. However, now that the action was no longer an initiative by the students, they seemed to have lost heart. If done at the behest of the teacher it became little more than the mechanical carrying of buckets of lime on to the ice, and students were not enthusiastic. They no longer held the locus of control; they were not autonomous.

From liberty to logic?

Being in control of their own education is very rare for children. Not only do they *have* to go to school until the stipulated age; they also *have* to submit to the ways in which teachers instruct them. In the education given to our children in schools over the ages there have been centuries of beating, together with an absence of liberty of any kind. Even in the Enlightenment the philosopher John Locke, who wrote so eloquently and passionately about freedom, justice and the civil society, could see no use at all for liberty in the context of school education. 'Liberty and indulgence can do no good to children: their want of judgement makes them stand in need of restraint and discipline' (1693).

There had been just one outstanding exception to this rejection of freedom for the learning youngsters, and that was from the inspirational educational philosopher Jan Amos Comenius. About thirty years before the above quotation was written, and in good time for Locke to have read it, had he cared to do so, this great European teacher had summed up his life's work on education in just three main principles. The second and third of these might almost be called the first charter for autodidacts:

1. Proceed by (small) stages.
2. Examine everything yourself without submitting to authority (which Comenius, rather unfortunately, called 'autopsy').

3 Act on your own impulsion: (Comenius' term was 'autopraxy'). This requires, with reference to all that is presented to the intellect, the memory, the tongue and the hand, that pupils shall themselves seek, discover, discuss, do and repeat, without slacking, by their own efforts.

There is much more that could be written about Comenius—his admiration for Francis Bacon's New Atlantis where all of science would be discovered and verified by open experiment, his strong opposition to any form of corporal punishment, his inclusion of girls and also of those whom we would now call students with special needs like Gillian, and his insistence that education must continue throughout life. Comenius' views on sensual intelligence, mostly residing in the hands, led him to recommend 'learning through doing' so that the students could practise autonomy while learning the practical arts and crafts.

The Age of Revolutions which followed was largely inspired by the stern non-humanistic views of the French Enlightenment philosophers, like Voltaire and Condorcet. Only J.-J. Rousseau (1968 [1762]) was an exception to this. He began his book *The Social Contract,* with the famously phrased dilemma, as he saw it, 'Man is born free, and yet everywhere he is in chains'.

Very little of what Rousseau taught was put into practice at that time, perhaps fortunately, since it reads to us now as a sadly isolated sort of education in a natural but empty environment. (It is also revisited in Chapter 17.)

In the new United States of America the exhilaration of liberty echoed around a society which did not primarily aim to reproduce the education of the old Europe, nor deliberately to reform it. Their hero, Benjamin Franklin, was a far more practical man—an inventor, and patently some kind of autodidact himself. He was apprenticed to a printer because his parents could not afford to send him to school, so while he was setting up the print, he self-educated himself by reading the books. When still only 25 he recognised his debt to this process and set up the earliest American subscription library in Philadelphia. Twenty years later Franklin wrote a paper entitled 'Proposals for the Education of Youth in Pennsylvania' which was to be in the 'useful arts and sciences'. To this day there is a subject in American high schools called industrial arts which in England might be called design-technology (see also Hunkin's comments about the Useful Arts in Chapter 11). There was no snobbism in the new USA about being an engineer or an inventor rather than an arts person. Quite the contrary.

A successful inventor is likely to be an autodidact. Ideas form in the students' heads when they design and make their own inventions, and there is a huge emphasis on being original (Solomon 1998, Roth 1995). As Margaret Boden says in Chapter 2, 'Most artists, musicians, and scientists earn their living by relying on exploratory creativity. Many of their new ideas are novel to everyone, not only to themselves'.

Inventors fit perfectly into this class, and Benjamin Franklin, who was successfully inventing bifocal spectacles at the age of seventy, never stopped having combinational creative ideas with useful applications, and sometimes with amusing ones like the ladies' parasols which carried a lightning conductor connected to a trailing earth wire! From time to time Franklin had real top-class 'transformational' ideas (see page 26), like those which completely changed our understanding of the nature of electricity.

There is another point to include here. Franklin characteristically mixed humour with his work. For example, there is an account of an 'electric picnic' which he set up with his scientific colleagues. They ate a turkey which had been electrocuted, lit the fire with an electric spark, and even gave their wives electric kisses by holding on to a charged Leyden jar at the same time. (What did their long-suffering wives think of that?) Tim Hunkin's work in Chapter 11 may fit into the same behaviour pattern. In Chapter 12 we see Indian folk-mathematics, which was born in the marketplace, also being turned into riddles and jokes. This surprising aspect of the psychological side of autodidactism will be examined further in Chapters 16 and 17.

Critical political education

The nineteenth century saw adult education emerging in Britain. There was pressure from workers who wanted to know why it was that they seemed destined to live in conditions of such poverty with no hope of betterment. By the early decades of the nineteenth century there was also growing anger. No longer was there to be sentimental and patronising poetry like that of Thomas Gray from the previous century.

> Some village-Hampden, that with dauntless breast
> The little tyrant of his fields withstood;
> Some mute inglorious Milton here may rest,
> Some Cromwell guiltless of his country's blood,

The nineteenth century's Hampdens, Miltons and Cromwells had no intention of being mute. They had a thirst for learning, especially those in the Chartist movement who were seeking what we could now call their human rights. While the bloody and glorious revolution in France had made little change to the workers' social conditions, this angry British movement did. Slowly by our measurements but rapidly by those of previous centuries, workers seized upon every opportunity to make learning more accessible. The workers were certainly novices in education but they knew what knowledge they wanted. A new shift in autonomous learning was about to take place.

Chartism was founded in 1838, the first specifically working class movement in Britain. In addition to universal male suffrage its members had dreams of a new social order, and its numbers grew stronger every time unemployment increased, or there was an increase in the price of corn. As Richard Johnson (1993) has eloquently written, what the Chartists wanted was 'really useful knowledge' in a political sense. What they wrote about the light-hearted antics of the British

Association makes uncomfortable reading in these days of colourful promotions for the public understanding of science. 'A man may be amused and instructed by scientific literature but the language which describes his wrongs clings to his mind with unparalleled pertinacity.' Poor Man's Guardian, 25 October 1834 quoted in Johnson (1993).

The Chartist movement withered away in the second half of the nineteenth and the early twentieth century under the influence of increasing affluence, and before all of its educational objectives had been achieved. Other political movements which also looked forward to a new social order were to follow. Whether it was anarchism in Germany, or Marxism in Europe, or post-colonial emancipation in South America there were always educators who wanted to go beyond the occasional reductionist comments of John Dewey (1916) that the second grand aim of all education was social efficiency and industrial competency. Dewey did himself realise the danger that this aim might pose in the hands of an autocratic commercial regime, and wrote that the truly democratic path was to pursue the development of practical skills only up to the minimum age of individual career choice.

Meanwhile revolutionary authors like Illich (1963) and Freire (1970) argued that education needed to be both individually liberating and socially and politically emancipatory. They argued against schooling and they preached their doctrine with such vehemence that, in some cases, it began to transgress the bounds of individual judgement which are always so precious to autodidacts. Freire was explaining cultural choice as 'action which was to become a preoccupation to the masses'. Was there any room within that definition for the individuals who did not want to follow the general preoccupation? By the 1990s Henry Giroux (1997) had begun to critique the whole idea of autonomous choice in learning. His 'pedagogy of hope', promoted a process by which the teacher could bring relevant topics closer to the students and then encourage them to 'make their voices heard'. This echoed a new approach to autonomy and hence to democracy itself.

Throughout the centuries, from Comenius to the present day, there have always been a few alternative voices in education who argued on behalf of autonomy. Wherever alternative schooling became popular or even possible during the nineteenth and twentieth centuries, there was an argument for freedom for young people to learn from experience as and when they wanted. Once again the question of informal livedlearning was discussed, along with the old and difficult question of teaching as indoctrination.

Education in the working group

The idea of a lone, self-actualising person teaching themselves in some isolated space seemed far too individualistic for modern sociological thinking. Could a child or adult really profit from such an empty environment if learning was going to depend on experience? Vygotsky's work, as has already been discussed, went some way towards suggesting that reflection was at least in part a social process.

We may imagine the friend we will be meeting and try to rehearse what they are going to say. The engine for this is our memory of previous social encounters. So it is our social life that not only teaches us how to reflect and learn, but also lives on in our reflections, and even in the constructions of ourselves.

The concept of the self is slippery because of our surprising capacity to take on different roles whenever needed. In conversation we are always anxious about whether we are properly understood. So we continually ask others if they 'know what I mean?' These points were made many years ago by the sociologist G.H. Mead (1937).

> The individual is continually adjusting himself in advance to the situation to which he belongs and reacting back upon it. The self is not something that exists first and then enters into a relationship with others, but is so to speak, an eddy in the social current and so still a part of the current.
>
> (p. 182)

It is obviously vital to understand the operation of self in the context of autodidactism, and this will be a substantial part of Chapter 17.

Almost all learning situations are social, but if the learner can almost disappear into the setting, as new apprentices on the periphery of a loose apprenticeship group may do, or by being with a gang of friends discussing a project, then any learning which takes place may seem experiential rather than formal. The more realistic and exciting environment of the work place has always been popular with students from school and further education, which is backed up by numerous reports from students on sandwich courses, and their tutors. All of this may well make it easier for an uncomfortable autodidact to learn without conflict with the institution and its teachers. In addition the situation will provide the social comfort of being with others.

But this method can also have drawbacks. As Hudson (1976) and others have pointed out, the apprentice master has always had tight control over his apprentices, to whom he may have passed on blind prejudices along with technical or academic skills. In the present time of rapidly changing technologies such fossilised apprenticeship practices could prove a disaster in personal and economic senses. New types of extended apprenticeships have been introduced which require more part-time study along with a specified range of certificated qualifications.

The first of two interesting books on this general theme of work and learning was written by Jean Lave. She set out to study how people did arithmetic in practical situations, like the supermarket, and after several years concluded that 'The same people differ in their arithmetic activities in different settings in ways that challenge theoretical boundaries between activity and its settings' (Lave 1988:3). In Chapter 12 of this book we examine a new study of practical mathematics as exhibited by Indian women market traders who have taught themselves mathematical methods and extend this to a wide cultural context.