Chapter 9

Comparison of Course Assembly Systems: Their Use in Teaching People to learn

All the operating systems have a functional as well as a systemic communality. Notably, all of them serve, in one way or another, as devices which foster a generalised positive transfer of ability, the art of learning without specific commitment to the subject matter being learned.

In Chapter 2, for example, we presented evidence from interviews and group discussion, together with some quantified evidence, of a generalised positive transfer of training due to experience as a participant in CASTE or INTUITION. Even these tutorial systems with a fixed conversational domain appear to foster *versatility* (both operation learning and comprehension learning, and in combinations able to cope with various classes of learning and teaching strategy). Such experience may or may not influence an underlying global/local bias; that is a moot point. But one thing is certain. Though versatility is a prerequisite for an ability to learn in an unstructured environment and though it is evidenced by students who have "learned to learn," versatility is not a sufficient condition. If the general art of learning implies putting together bits of unstructured experience, seeing the wood for the trees, and so on, then a student who has learned to learn must be able to assemble course material on his own account. Although we can examine this aptitute in the tutorial (or fixed domain) operating systems, they do not, just because the conversational domain is fixed, provide tools for studying how, if at all, people learn to assimilate raw data in their own way and, subsequently, to learn within the personally assimilated structure.

For this purpose, we must turn to the course assembly systems:

EXTEND (previous monograph) and THOUGHTSTICKER. As a preliminary, these systems will be compared with a focus on THOUGHTSTICKER, since it has much greater capabilities. Section 1 is devoted to a general overview, and Section 2 spells out the comparison in terms of the macrotheoretic variables of uncertainty and doubt (previous monograph). Section 3 is an attempt to bridge the gap between definitively innovative situations and more commonly observed "learning" situations in which, however, successful students are required to structure the environment on their own. Sections 4 and 5 contain an account of some experiments in which principles, winkled out from experience with the operating systems, are used to inculcate the art of learning in general.

1. PROCEDURAL COMPARISON BETWEEN THOUGHTSTICKER AND OTHER OPERATING SYSTEMS

When learning the topics in the starting set of disjoint substructures, the user has the role of a student in a strict conversation, which is CASTE or INTUITION regulated. Later, under the control of THOUGHTSTICKER proper, he has the role of subject matter expert or innovator. We noted, in Chapter 8 of the previous monograph, that a similar transition takes place when EXTEND is called into play. But THOUGHTSTICKER exteriorises innovation, whereas EXTEND merely permits it and records the product.

1.1. One salient feature of the CASTE organisation is that a student "drops into" a conversational domain representing knowable topics from "top to bottom". He arrives at the learning session with certain concepts in his mental repertoire. He *must* have concepts for the primitive topics, but he *may* have concepts for topics at a superordinate level. Whatever topics he does have concepts to represent are initially marked as understood, and these the student may regard as properties.

The top to bottom orientation (in contrast to the assumption that knowledge is built up from elementary fragments) is dramatically manifest by the order in which an *understanding* is reached; the derivation is first sensed (at which point the student knows *how* he can explain the topic, *if* he can explain it). A correct explanation (the other evidence required for an understanding) comes *after* the derivation. Or, phrased differently, the student knows the kind of model he can build as a non verbal explanation of the topic before either he or the regulatory heuristic knows whether he can, in fact, build a correct model.

1.2. To realise a strict conversation and to exteriorise *understanding* we also imposed a polarity, expressed in the experimental (tutorial) contract, to the effect that the student learns towards a head topic. Considerable stress was placed (notably, in Chapter 7 of the previous monograph) upon the inessential nature of this constraint. Under many descriptions of the same conversational domain, a student can learn his way through the topics in *any* direction; the restriction is introduced to facilitate regulation and observation and to represent the dialogue as a series of discrete occasions (one for each understanding) at which cognitive processes begin and end.

1.3. To demarcate occasions (which is essential in a strict conversation), we pay the price of enforcing the one and only one-aim-at-once condition; and we noted, in context, that students are inclined to rebel against this restriction.

1.4. Much the same polarities and constraints apply to EXTEND control when the student opts into the role of a subject matter expert. EXTEND permits the introduction of fresh topics, and the conversational domain evolves. But there is still one-aim-at-once; there are still discrete occasions; there is still a directionality attached to the method of course assembly permitted by the operating system. These are not so much restrictions upon cognition as restrictions upon those aspects of cognition which can be exteriorised as behaviours. It was conceded and emphasised that the restrictions hampered the subject matter expert, though on balance he gains more from using the system than he loses by accepting its authority as arbiter of legitimacy.

1.5. Moreover, in course assembly under the EXTEND program, these constraints add up to produce a (fairly salutary) dictate. The subject matter expert produces the syntactic component of his thesis *first* (the derivations and the explanations), and the semantic descriptions *later*.

1.6. THOUGHTSTICKER permits and sometimes encourages many aim operations; the simultaneous production and comparison of models; the formation of generalised (not only isomorphic) analogy relations.

1.7. Thus, all the constraints noted in Section 1.1 to 1.5 are relaxed. By dint of a much more complex organisation in the operating system, it is possible also to exteriorise an appreciably greater body of cognitive processes and, at the price of some observational ambiguity, to exteriorise most facets of innovation.

1.8. For example, although the user (in his course assembly role) may work from "top to bottom," he may also do the reverse (making a model first, explicitly, and instating a topic later). He must still have a head oriented polarity under one thesis, but he may also (and usually does) entertain several theses to be merged later. Although he may output the syntactic form of this thesis (or theses) first and their semantic description later, he may also choose to construct a framework of descriptors and build a thesis within this ossature. Finally, not only may he reverse the order

Derivation → Explanation (model)
into
Explanation (model) → Derivation

with respect to models built as non-verbal explanations in the one or many $MF(z)$, he may also, insofar as the data bank is described (channels or a par with topics), impute meaningful behaviour to whatever lies behind the data bank. Thus, the following sequence is quite legitimate.

Explore data bank → Impute behavior → Model it in the $MF(z)$ → Give derivation.

2. ALTERNATIVE AND MACROTHEORETIC DISTINCTION BETWEEN OPERATING SYSTEMS

It is possible to characterise a one-aim-at-once operating system (any of them at all) in terms of the attentional uncertainty d_0 calculated in the course of <u>aim</u> validation and the uncertainty variable d^* (Chapter 6, Section 11), which is computed with respect to a finite (though open ended) list of nodes.

For a one-aim-at-once system, the experimental contract demands that $d_0 = 0$ (or nearly so) if an aim is validated; since there may only be one aim, this implies that $d^* = 0$ (some one aim is selected and the participant contemplates no other). Although it is impracticable to obtain confidence estimates over the entire set of nodes (topics, channels, or whatever), the index d^* is usefully approximated by presenting the set of nodes which have been at least once explored during the last m occasions ($m = 12$ is arbitrary, but satisfactory). If these are alternatives for aim selection, as they are by edict in a one-aim-at-once system, the already stated covariation of d_0 and d^* is anticipated. By eliciting confidence estimates over the explored node set during a sample of explore transactions, we obtain empirical variation curves of d^* and d_0 (a *discrete* value, sampled at aim).

For THOUGHTSTICKER or any other many aim system, this constraint no longer applies. The user may appreciate, be certain about a description for, and validate his aim with respect to, several topics at once. Hence, the confidence estimates upon which the calculation of d^* are based do not sum to unity; d_0 and d^* are not expected to covary; their empirical estimates do not do so. One way of phrasing the difference is to point out that in a many aim system d^* is not a probability or uncertainty measure but a Fuzzy Set measure and that in a many aim system the topics are necessarily Fuzzi Predicates as proposed in Chapter 4, Section 2 (the very far reaching consequences of this remark are also considered at that point).

3. AN OPERATIONAL DEFINITION OF LEARNING TO LEARN: ITS RELATION TO INNOVATION

It was argued in Chapter 2 that certain students have a generalised and apparently transferable ability to *learn;* regardless of the subject matter they face, these students are able to assimilate it. Their ability to do so depends upon several factors. They can structure an otherwise unstructured environment by acting, in this respect, as personal subject matter experts; having done so, they must exhibit versatility (both *DB* and *PB* competence, Chapter 5) in executing learning strategies. Neither skill on its own is sufficient to qualify the student; on the other hand, the skills in question are correlated and probably interact positively rather than interfering.

All this amounts to a sloppy categorical specification. If learning to learn (by experience) or teaching people to learn (under duress or persuasion) deserve the elevated station in the educational system ascribed to these activities in Chapter 2, it is essential to give an operational definition of the competence or ability thereby inculcated. Such a definition is available and is tantamount to the bald statement that an ability to learn (the skill) *is* an ability to employ THOUGHTSTICKER, producing a sensical output when the unstructured subject matter/environment is the active data bank and when the output structure is formed on the grids above the starting substructure. By hypothesis, this much, but no more than this, need be said; for THOUGHTSTICKER determines a well-specified process, albeit open ended, which either can or cannot be handled.

In common with the other operating systems, CASTE and INTUITION, there is still an irreducible but, practically speaking, harmless ambiguity. Does our definition refer to a test for "ability to learn," or does it act as a training device. Clearly, it may do both and the functions are inseparable. For the system is (amongst other things) an "epistemological laboratory" containing principles which may be instilled. Some of these principles are well entrenched pieces of conventional or academic wisdom (though they are not often recognised explicitly by students). Others, like "epistemic symmetry" and "inversion" are debatable; all the same, they are upheld by common sense as well as by theoretical doctrine.

The evidence suggests, moreover, that the use of THOUGHTSTICKER has a powerful training function. Just as a student with a defective repertoire acquires versatility in CASTE or INTUITION if only by virtue of seeing his own "Globetrotting" or "Improvidence," so the user of THOUGHTSTICKER "learns to learn" even if he cannot do so at the outset.

The data available are sparse for two reasons: (a) The experiments are lengthy, arduous, and form part of a phased and ongoing study of innovation. (b) To secure the kind of result which is called for requires a rather special operating condition.

Under (a), the current results only attest to the existence of a training function; its magnitude and reliability cannot yet be stated. The examples of Chapter 7 are however quite typical. Whereas the "reinvention" of Brillouin's work was due to an adult, youngsters "reinvented" the Savery mining pump and various ingenious composite engines (often with fields of application quite bizarre to the adult mind). That analogical structures relating these "fields" (or, in our jargon, "universes of interpretation") are far more complex for younger people is suggested by the relatively tidy and sober minded thesis of Fig. 7.1. At first sight, more significant information about learning to innovate will come from comparing transactions and relational structures than from a gross, numerical comparion; at any rate, our conviction that the system has value stems chiefly from such evidence.

Under (b) "learning to learn" rather than "learning to innovate" calls for a situation dominated by the data bank as a source of information on a par with odd texts in a library or odd experiences in streets and airports or laboratories. The required conditions are shown schematically in Fig. 9.1. The user picks up information from an initially unstructured data bank. On the basis of this information, he makes models in the $MF(z)$ and seeks to delineate a thesis by building a cognitive model, mesh, or network on the construction grids. Having done so, he is in a position to describe his thesis, and (since channels are placed on a par with topics, and furthermore, since the channel output, rather than invention alone, engendered the models) any description of the thesis will be relevant to and descriptive of the channels (usually one channel to a cluster of topic nodes in the mesh). The thesis and data bank description (together with the mesh of the thesis which forms the glue that sticks one descriptor to another) is one of the personalised structures we are anxious to exteriorise.

The distinction between this mode of operation and the current mode is to some extent a matter of degree; for example, exactly this cycle of activities can, and occasionally does, take place. On the other hand, it is hardly encouraged by a subject matter like "conservation and conversion of energy". The "oscillators" environment, mentioned in Chapters 7 and 8, is a more fertile field of enquiry insofar as the data bank is esoteric (indexed by author names and containing extracts from Apter, Beurle, Gaines, Osnager, Prigogine, and many others). But, this environment has so far been little used.

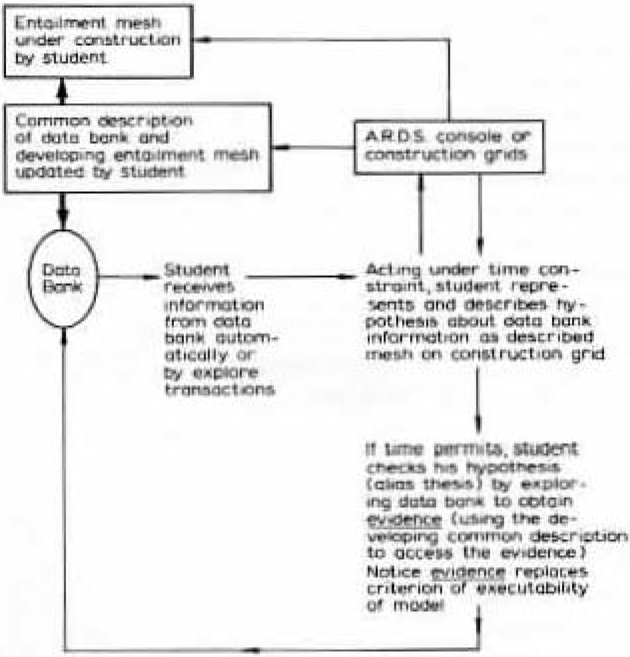

Fig. 9.1. Outline of the THOUGHTSTICKER configuration required for experiments on "learning to learn" and "learning to structure disorderly experience" (the data bank dominates the system; face validity is established by appeal to evidence from the data bank).

A further distinction between the current and the desired mode is as follows: People who are learning frequently act under duress induced by a time constraint; for example, an examination date looms up in the future. Under these circumstances, innovation (in particular, innovation based on "epistemic symmetry") occurs in order to guess at parts of the subject matter which have not been covered. It is not innovation for convenience, or for its own sake, or with much pretence to success. It is innovation of necessity and is very common. It follows that an ideal experimental situation would impose a time constraint likely to be incompatible with the implementation of the present system (though not with the next generation THOUGHTSTICKER under construction). Generally, we feel that investigations are better carried out by other means for this reason.

A final difference between the current and the desired mode of operation is that learners, qua students, are inclined to accept the rectitude of data sources (wisely or not). As a result, canons of workability depend upon whether the data bank (or any particular channel) "says it works". At all events this is what the examiners "want to know". It is quite easy to incorporate the necessary bias into THOUGHTSTICKER, but it is incompatible with the conduct of general experiments on the system.

Under these circumstances, the dogma, honestly and unreservedly enunciated in the introduction, comes to our rescue. Although a theory of educational learning and knowledge must rest upon a well-specified experimental scheme (and in practice if only due to the magnitude of the conversational domain, this implies an operating system like THOUGHTSTICKER), the main use of the results in an educational or institutional context does not involve the operating system directly. Principles of instruction may be extracted from the results produced by CASTE transactions; by the same token, principles of "learning to learn" are readily extracted from the results obtained in THOUGHTSTICKER. If a tutorial (rather than experimental or comparative) object is dominant, most of these principles can be presented, demonstrated and recommended for adoption by any convenient mode of advocacy, for example, in a classroom to a group of interested students.

This expedient has been adopted in experiments chiefly due to B.C.E. Scott and Elizabeth Pask, using the following design.

4. CLASSROOM EXPERIENCE

A group of between 10 and 25 students (age 20 to 35 years) are asked to attend sessions in which they will "learn to learn". On arrival, they are told the following innocuous "story" to form a work setting.

You have been attending a class called "Cosmic Processes". It includes diverse material: the study of Kant, Engels, Bateson, Casteneda, Einstein, Schroedinger, Blum, Kuhn, Kelly, and others, but the course content is inherently interesting and open to personal interpretation. For one reason or another (politely, we do not ask what reason), you have failed to attend the lectures provided. Hence, you are substantially ignorant of the content of the course. That is lamentable since tomorrow you face an examination on the course which you intend to pass. As might be expected, the examination is made up chiefly of essay questions evoking replies to "how" and "why" questions, and there is a marking bias in favour of answers that give some idea of how you arrived at your conclusion: Consequently, most of the questions are open ended. However, the examination is laden with a few factual questions which are more than makeweights.

Something can be done to extricate yourself from the dilemma of entering the examination room without proper study. We have here copies of all the texts used in the course, and they have been edited down to extracts which (though weighty) can be read in approximately 2 hours. You have 2 hours (or slightly more, in fact up to $3\frac{1}{2}$ hours) to study these materials.

At this point the experimenter presents the *Session A* texts (Table 9.1) and leaves the students to mull over them. Students leave the experimental room when they have got as much as (they think) they can from the material.

Although reading rate is not, in the population sampled, a limiting factor, the experience is pressing and for some students positively traumatic. A few break down emotionally, or literally escape. Those who remain are submitted to an examination, liberally augmented by Piaget like interviews.

Session B, when the group next gathers, is devoted to a training and demonstration exercise. This session lasts for several hours and exhibits the major pathologies of learning (Chapter 5), their explication in terms of *DB* and *PB* operations, and the salient principles of THOUGHTSTICKER. Within the limits of a classroom session, the students are required to do and see for themselves, not merely to listen to a lecture.

Finally, *Session C* is a virtual replication of *Session A* using *different* materials (Table 9.1) and is again followed by an examination and Piagetian interviews.

The usual controls are applied. The materials employed in Session A are found to be of comparable difficulty to those employed in Session C; for some groups, Session A materials are used first, and for some groups, Session C materials are used first. Possible practice effects are controlled by interpolating inactivity in place of the (training) Session B (and found to be negligible; if anything, performance gets worse unless something is done to eliminate the confusion produced by assimilating a large and indigestible mass of data). For all that, and presumably as a result of indoctrinating students with THOUGHTSTICKER principles in Session B, there

TABLE 9.1

"Learning to Learn" Experimental Materials

Session A Texts: K. Walker: *A Study of Guardjieff's Teaching* (Chapt. 7). F. Engels: *The Dialectics of Nature* (Chapts. 2 and 10). J. Lilley: *The Cyclone's Centre* (Chapts. 11, 13, 14, 15, 15, 17). J. Clarke: "A Map of Inner Space," in *Six Approaches to the Person*, R. Buddock (ed.). C.G. Jung: Extracts from his Introduction to Richard Wilhelm's translation of *Secrets of the Golden Flower.*	
Session B	Training session (special materials).
Session C Texts: L. Wittgenstein: *Tractatus Logico-Philosophicus* (extracts). A. Schutz: *Collected Papers: 1. The Problem of Social Reality* (extracts). W. Heisenberg: *Physics and Beyond* (Chapts. 9 and 20). E. Schrodinger: *What is Life?* (Chapt. 4). C. Castaneda: *A Separate Reality* (Introduction and Chapts. 5 and 17). C. Castaneda: *Journey to Ixtlan* (Chapts. 15 and 20).	

is a very marked and statistically significant improvement due to Session B practice. These results are shown in Table 9.2, and the acquisition of an "ability to learn" is most marked in terms of the "how" and "why" questions for which the answers are derivations and explanations mostly innovated by the students. Graphic responses (for example, flow and connection charts) are encouraged. In this arrangement the materials used in Session A and Session C correspond to the THOUGHTSTICKER data bank, and in Session B, to a stripped down operation of the THOUGHTSTICKER system.

Various compromises and classroom administrable techniques have been tried. Details of the currently used technique, which works well for 5th and 6th form students, are given in Appendix C. It is a practicable, fairly inexpensive method tested over some 120 students; it can be used also for adult populations, and a modified version is being piloted for use in primary schools.

TABLE 9.2

Learning to Learn, Experimental Data

Subject Number	Pretest score	Posttest score	Complexity of graph (pretest)	Complexity of graph (posttest)	Complexity Difference	No "+" topics pretest	No "+" topics posttest	Diff. test	Failed Subjects	No "+" marked topics pretest understood	No "+" marked topics posttest understood	Diff. test
1	50	55	60	84	+24	7	9	+2	—	6	9	+3
2	30	60	40	56	16	2	7	+5	—	2	6	+4
3	80	65	55	20	−35	10	4	−6	*	10	4	−6
4	55	50	47	51	4	7	3	−4	—	5	3	−2
5	60	75	35	78	43	4	8	+4	—	4	8	+4
6	25	45	26	65	39	1	2	+1	—	1	2	+1
7	35	55	34	66	32	5	9	+4	—	4	7	+3
8	25	47	25	57	32	1	6	+5	—	1	5	+4
9	20	55	20	47	27	1	6	+5	—	1	6	+5
10	45	50	40	80	40	1	2	+1	—	1	2	+1
11	45	50	32	49	17	4	10	+6	—	3	10	+7
12	35	60	15	35	20	4	7	+3	—	4	7	+3
13	50	70	46	84	38	5	9	+4	—	5	9	+4
14	40	65	42	86	42	6	8	+2	—	6	8	+2
15	60	85	57	61	4	3	2	−1	—	3	2	−1
16	70	65	34	36	2	5	7	+2	*	5	7	+2
17	55	37	36	18	−18	5	5	0	*	5	4	−1
18	52	40	25	10	−15	10	8	−2	*	8	6	−2
19	63	77	36	58	22	8	12	+4	—	3	11	+8
20	56	71	61	79	18	8	12	+4	—	6	1	−5
21	37	44	11	26	15	7	12	+5	—	6	10	+4
22	15	20	44	68	24	5	6	+1	—	5	2	−3
23	65	67	32	48	16	5	12	+7	—	4	11	+7
24	78	81	55	70	15	12	29	+17	—	1	10	+18
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	*	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	11	8	−3	—	1	8	+7

28	71	51	[illegible]	[illegible]	27	[illegible]	12	+3	—	9	7	−2
29	59	80	46	67	21	5	14	+9	—	1	12	+11
30	78	43	44	25	−19	8	16	+8	*	7	6	−1
31	45	60	30	56	26	4	9	+5	—	4	7	+3
32	40	30	29	8	−21	9	12	+3	*	7	2	−5
Mean	50.7	58.2	39.6	54.2	14.5	6	9.1	3		4	6.7	2.66
SD	17.34	17.37	13.71	22.76	20.91	3.244	5.192	4.242		2.565	3.804	4.976

Mean	47.92	62.2
SD	16.96	15.79

For $n = 25$ excluding subjects marked "*" in "Fail" column who dramatically failed to learn and with graphs that degenerated, on posttest, into disjoint subgraphs.

Statistical Summary

Posttest score > Pretest score (all subjects n = 32) t = 1.73 (0.1 > p)

Posttest score > Pretest score (*excluding* subject who *failed*, by graph criterion or behaviour, marked "*" but *including* those who could already learn before training, n = 25) t = 3.03 (0.01 > p).

Graph complexity after training > Graph Complexity before (all subjects, n = 32) t = 3.13 (0.01 > p).

Topics marked "+" after training > topics marked "+" before) (all subjects, n = 32) t = 2.77 (0.01 > p).

Marked topics understood after training > marked topics.

Understood after training (all subjects, n = 32) t = 3.33 (0.01 > p).

When the Spy Ring History Test is administered (some 18 of these subjects) there is a positive correlation between versatility and score difference significant at 0.001 > p).

Control Data

(a) No training interpolated (n = 12) *reversed* trend in test scores t = 1.218 (0.1 > p).

(b) Materials A before materials C (n = 15 subjects) pretest score mean = 49; SD = 17.06. Posttest score 61.3; SD = 21.4. Difference mean + 12.8; SD = 20.44.

(c) Materials A before materials C (excluding laboratory subjects, n = 11) Pretest score mean = 51.8; SD = 17.27; Posttest Score Mean = 56.6; SD = 21.26, Difference Mean + 5.7, SD = 16.23.

(d) Materials C before Materials A (reversed learning material) n = 14 subjects. Pretest score mean = 55; SD = 18.95. Posttest score mean 71: SD = 18.25, Difference mean + 15.43, SD = 21.8.

(e) Materials C before Materials A (reversed learning material) excluding laboratory subjects, n = 9). Pretest score mean = 59.6, SD = 12.33; Posttest Score Mean = 64.9, SD = 17.73; Difference Mean + 5.33; SD = 15.89.

Comparison of Control Data

b/d and a/c pretest mean differences t = 0.9 (not significant) posttest differences.
t = 1.136 (not significant). Group Differences b/c and d/e; t = 0.336 (not significant); t = 0.051 (not significant).

5. DISCUSSION

The average improvement fostered by a THOUGHTSTICKER technique is unequivocal. For subject matter which is so heterogeneous and sometimes recondite, it is hardly necessary to question the transferability of any skill which is acquired.

We do not claim that everybody "learned to learn". An appreciable number of the students opted out (especially before the latest technique was introduced). We conjecture that this is the main reason, in practice, why people do not "learn to learn". A few who stuck out till the end of the experiment gained little benefit, but these form a small percentage of the total. Most students who did not benefit already had the general learning skill in their repertoire at the outset, so that they cannot for this reason be said to have learned a novel art. The great majority of students who were initially naive and who did stay through the experiment showed a major degree of improvement. Further, judging by their comments during the interviews, they enjoyed the experience, found it useful, and became aware of how they set about learning.

Amongst the students who did show evidence of learning the art of learning in the course of the experimental sessions, there are two groups of special interest.

(a) Students whose response at the first examination indicated that one (or at the most two) text passage had been picked out for scrutiny and the rest neglected. Apart from the severe time constraint imposed by the work-setting, these students might have been adept "serialists" or they might have been "improvident" learners (with a purely arbitrary, sequential-looking, learning strategy).

(b) Students whose replies at the first examination showed every sign of "Globetrotting" over some or all of the text passages. Given longer, they might have been successful "holists". As it is, they answered questions in terms of loose, distorted, or even purely nominal pseudo-analogies (generally, noting similarities and neglecting differences; invariably, unable to explain the topics thus linked together).

It was sometimes possible to observe gross features of explanatory behaviour during the learning session, and these observations, when available, are commensurate with the pattern (a) or (b) detected in the examination phase.

After the training session B, the majority of these students, type (a) or type (b), improved their performance in terms of absolute score on the examination following Session C. The time constraint upon learning in Session C is just as stringent as it is in Session A, but judging from the students demeanour whilst learning, it is far less bothersome. Nearly all of the students imposed a structure of their own upon the texts, were both conscious of doing so and able to recall the structuring scheme (often graphed or charted on paper). Students of type (a) enlarged the scope of their explanation (occasionally falling into the "Globetrotting" snare), whereas type (b) students concentrated on satisfactory explanation and derivation, as though compensating for their original defect (at the training session they were probably still aware of their performance and thus able to obtain corrective feedback from the training).

Observation of behaviours and protocols support the main conclusions based upon a smaller sample of well-controlled results and upon the theoretical argument, namely:

(1) Innovation involves the resolution of many aims to produce one.

(2) This may occur in one person (brain) if it is inhabited by more than one P-Individual.

(3) It may, equally well, occur in groups of several people.

(4) Course assembly is replete with innovation.

(5) Innovation, "course assembly" (in the technical sense of this book) and "learning to learn" are tied together by a common process, which also sets them apart from less creative learning.