

EDUCATING ADAPTIVE ACTUARIES

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Abstract

Continuing change pervades the actuarial world. Actuarial tools and techniques are constantly evolving; new financial products and services appear regularly; legislation and regulation rarely remain unchanged for long; consumers are becoming better informed and more sophisticated; the financial environment becomes increasingly global; distinctions between types of financial institution become more blurred; the areas in which actuaries find applications for their skills become more varied. In this context, the most important attribute for actuaries is the capacity to adapt.

This paper considers some implications for university actuarial programs of the need to develop adaptive actuaries. It discusses the results of a survey of the preferred learning styles of Macquarie University actuarial students, examines the newly introduced Australian actuarial subject called *The Actuarial Control Cycle*, and looks at the use of portfolios of student work. It concludes that in order to develop adaptive actuaries for the 21st Century, actuarial programs must broaden the range and type of teaching/learning activities and assessment methods provided for students.

Introduction

The environment in which actuaries practise is characterised everywhere by change. Change is regular and rapid. New financial products and services are emerging in a steady stream. Convergence in the financial services sector sees similar products being offered by banks and by insurance companies, while at the same time the financial risks involved in those products may be treated differently in the two sectors. The effects of globalisation are being felt in financial markets everywhere. Mergers are commonplace, both within and across national boundaries. Consumers continue to become more knowledgeable, sophisticated and demanding. Financial regulation changes often but struggles to keep pace with the implications of these other changes.

Partly in response to these changes, partly through competition from other disciplines, and partly through on-going research, the technical tools and methods with which actuaries perform their trademark risk classification, pricing, reserving and financial risk monitoring functions are continually evolving or being upgraded. Today's tools and methods will not be current indefinitely. Actuaries are finding new areas in which to practise, mainly as newly qualified younger members of the profession find work in firms which have not traditionally been significant users of actuarial services. The demand for actuaries in life insurance and pensions work, for long the major areas of actuarial activity, appears, at best, to have lessened. Actuarial associations are now taking lifelong learning seriously, by introducing continuing professional development requirements of their members.

Not surprisingly, given this climate of change, actuarial education programs are also changing. North America, the UK and Australia have all recently conducted significant revisions of their programs, and South Africa is in the process of debating how to change its system.

Need for adaptive actuaries

In this kind of environment, it is vitally important for actuaries to be adaptive; to be able to accept, understand, live with and respond to change in all its manifestations. There are two senses in which actuaries must be "adaptive": firstly, individual actuaries need to develop this attribute; and, secondly, the actuarial profession corporately must be adaptive by allowing and encouraging as much diversity as possible within its membership.

This paper examines how the actuarial profession can achieve these two dimensions of adaptability - the individual and the corporate. The key, it is suggested, is the education of actuaries. Actuarial students must be encouraged and enabled to develop knowledge, skills, attitudes and insights which are transferable, and not locked into the context, traditions, practice and other constraints of a particular narrow set of practice areas.

Actuarial education, of course, does not cease at professional qualification, but this paper focuses primarily on pre-qualification education.

As Bellis and Shepherd (1994, p 886) pointed out, when actuarial education is discussed, the focus is nearly always on the content - the material to be learned, or more accurately, the list of topics to be "covered". As far as content is concerned, the recent changes to the North American, UK and Australian actuarial education programs should tend to produce more adaptive actuaries, because they introduce students to a broader, more general range of statistical and mathematical tools than in the past. This new set of fundamental tools should prove to be more transferable than the life insurance and pensions based set of the past. However, syllabus changes alone are not sufficient. The whole curriculum must be addressed.

An educational curriculum is much more than just a syllabus. While the syllabus is important, equally or perhaps even more important are the learning goals and objectives, the approach to assessment and assessment tasks, the teaching and learning activities, the students' conceptions of knowledge and approaches to learning, the teachers' approaches to teaching, and so on. This paper considers how adaptability can be fostered through the whole curriculum.

Actuarial skills and attributes

Actuaries need technical skills, generic skills and professional attributes.

There is little doubt that newly qualified actuaries have strong technical skills. There is some debate, however, on whether the set of technical skills is the best possible set or the most appropriate set. That particular debate will not be addressed here. It is also important, though, to consider the extent to which those technical skills are transferable.

Generic skills for actuaries include :

- oral and written communication skills
- listening skills
- computing skills
- teamwork skills
- problem-solving skills
- learning skills

Typically, responsibility for the development of these skills has been left to students themselves, perhaps with employers playing an explicit role in some respects. For example, the joint study team of the UK Institute and Faculty of Actuaries (1997, p 794) proposed the new UK education structure on the basis of a model which "*concentrates on the development of core actuarial skills, and keeps non-technical skills as an employment-based activity, to be acquired alongside, or following, the actuarial qualification*". If the development, and formative evaluation, of these skills were explicitly built into actuarial education programs, not only would students tend to acquire these capacities earlier and more proficiently, but their learning along the way would be enhanced.

The development of professional attitudes and practices is usually not an explicit aim of actuarial education programs. Where it is referred to in the syllabus, it is usually not formally assessed, which of course gives students the clear message that it is not really to be taken seriously as a prerequisite to professional qualification. In Australia, for example, students must attend a two-day intensive seminar on professionalism after completing the

final two specialist examinations (see Figure 3 in Appendix 3). Participation in the seminar is a formal requirement for qualification as a Fellow of the Institute of Actuaries of Australia. There is no assessment of students' professional knowledge, skills or attitudes during or after the seminar. The situation is not dissimilar in North America and the UK.

Students who have spent several years attempting to hide their weaknesses from examiners can hardly be expected to become, overnight, objective and disciplined judges of when they do or don't have the appropriate knowledge, skills and experience to undertake a particular task or project. And this is just one aspect of being professional!

In the past, when nearly all actuaries worked for life insurance companies or for actuarial consulting firms, newly qualified actuaries usually had ready access to professional role models and mentors in the more senior and more experienced actuaries in their office. More and more younger actuaries are joining organisations which don't already have actuaries on staff. Today's and tomorrow's new actuaries are likely to lack the support structure enjoyed by the emerging actuaries of earlier generations. There is a double challenge here; firstly, for the actuarial profession to provide appropriate guidance and support for younger actuaries working in newer areas, and secondly, for actuarial educators to develop in actuarial students such awareness, skills and attitudes as will prepare and fit them for practice in such situations.

While actuarial education programs in Britain, North America and Australia have recently responded in terms of syllabus to the need to develop more adaptive actuaries, there are several other ways in which the curriculum can be improved. This paper considers three aspects which appear at first to be disparate but which in fact reveal considerable consistency :

- the implications of research on Australian actuarial students' preferred learning styles;
- a new and pivotal subject in the Australian actuarial education program (*The Actuarial Control Cycle*);
- the use of student portfolios in actuarial education.

Actuarial students' preferred learning styles

Research at Macquarie University on actuarial students' preferred learning styles (Shepherd, 1997a) suggests that the existing actuarial program may be influencing students to focus on certain modes of learning at the expense of others, without giving students opportunities to develop as well-balanced, all-round learners.

Appendix 1 outlines Kolb's Experiential Learning Model (ELM), and Appendix 2 describes Kolb's notion of learning styles, derived from the ELM.

In order to measure learning style preferences, Kolb developed the Learning Style Inventory (LSI), which was extensively tested for reliability and validity (Kolb, 1976). Subsequently, over 300 papers have been published which report research based on surveys of learning styles using the LSI. The LSI is designed to place learners in the plane represented in Figure 2 (Appendix 2) according to their preferred learning style.

In terms of Kolb's ELM model, it would be desirable for the actuarial profession, faced with on-going and rapid change, to have a membership which is able to learn in a variety of environments. It needs, as a body, to be able to bring to new challenges and problems a balanced and adaptive learning style.

Ideally, every member of the profession would have a balanced preferred learning style, well developed in all four modes of learning. In reality this is unlikely. However, the profession as a whole can still aim to have a membership which incorporates a diversity of learning style types (ie some Convergers, some Divergers, some Assimilators and some Accommodators). In this way, it will be able corporately to offer a balanced and adaptive learning style.

If this is to happen, actuarial education must not only allow, but must also foster and encourage, the development in individual students of all four modes of learning. Early evidence from a research program at Macquarie University (Shepherd, 1997a) suggests that this balanced development is not evident. The program involves using the LSI to measure the preferred learning styles of actuarial and other university students.

The study found that, over the three years of the Macquarie actuarial program, there was little change in average preference on the Abstract/Concrete dimension, but that there appeared to be a significant increase in preference for the Active end of the Active/Reflective continuum. There was an increase in preference for Active Experimentation, as well as a decrease in preference for Reflective Observation.

Further, the distribution of learning style types changed markedly over the three years. Table 1 shows how 'Assimilator' was the most prevalent learning style type (LST) in first year and second year, while in third year 'Converger' accounted for about half the group. 'Diverger' decreased by more than half over the period surveyed.

Table 1 : Percentage distribution of respondents by learning style type within group

Learning Style Type	First year %	Second year %	Third year %
Converger	16	33	49
Assimilator	42	38	19
Diverger	32	19	14
Accommodator	10	10	19
No. of students included	60	42	43

It must be noted, however, that these results are based on the measured preferences of three cohorts of students. Any conclusions must be tentative. A longitudinal study is in progress to trace the same students for three or more years. It will also be necessary to test for any selective withdrawal effect due to students who opt out of the actuarial program in favour of some other course of study.

It could be that the types of teaching/learning activities available to the students in the actuarial program is influencing their developing learning style preferences. Wynd and Bozman (1996) classified a selection of common instructional activities according to the stage of the experiential learning cycle that they might best support (see Figure A).

Figure A : Instructional activities supporting experiential learning
Adapted from Wynd and Bozman (1996)

	CONCRETE EXPERIENCE	
ACTIVE EXPERIMENTATION	Observations/field work Simulation and games Reading basic texts Laboratory work	REFLECTIVE OBSERVATION
	ABSTRACT CONCEPTUALISATION	
	Lectures Papers Solving maths problems Model building Theory building Concept mapping	

During their program of study at Macquarie University, actuarial students encounter learning activities comprising mainly traditional lectures (100 to 500 students), tutorials (30 to 50 students) during which maths problems are tackled, weekly homework assignments consisting of maths problems, and assignments or projects requiring mathematical work and a written report. Assessment is usually heavily weighted towards a 3-hour written unseen examination, consisting largely of mathematical problems. Other learning tasks like essays, seminar presentations, group projects etc are likely to be encountered much less frequently.

The standard mix of learning activities for actuarial students thus very strongly supports the bottom (Abstract Conceptualisation) group, and to a lesser extent the left-hand (Active Experimentation) group. The other two groups (Concrete Experience and Reflective Observation) are almost unrepresented.

In the light of this inventory of typical learning activities, it is not surprising that there appears to be a trend towards a preference for "Converger" as learning style type.

Further research is needed, as noted above. However, there may be indications in these results that the actuarial program at Macquarie University needs to incorporate a wider range of learning activities so that students are enabled, and encouraged, to develop their learning skills in all four modes of experiential learning, and so that a balanced mix of learning style types is possible among actuarial students as they develop into practising actuaries.

The idea that the somewhat limited range of learning activities in the actuarial program is restricting development of students' learning styles is reinforced by a comparison, in the same study (Shepherd, 1997a), between two cohorts of first year actuarial students (the 1995 and 1996 intakes respectively). The groups showed significant differences on the Active/Reflective dimension. The group with the lower average (ie the group with the higher preference for Reflective Observation) had experienced in their first actuarial subject a range of learning activities different from the norm described earlier. As well as some of the traditional activities, they had also kept a reflective journal, written a reflective essay (eg *How and why has your concept of what an actuary is changed during the course of this semester?*), worked in a small group (3 or 4) to plan, research and implement a 15-minute presentation to their peers on an actuarial topic of their choice, and were assessed by a variety of methods including peer assessment.

The Actuarial Control Cycle

In 1996 this new subject was introduced as a key component of the Australian actuarial education system. It constitutes Part 2 of the four-part education program, which is shown diagrammatically in Figure 3 (Appendix 3).

The Actuarial Control Cycle (ACC) is the essential link between Part 1 and Part 3 of the education program. It deals with what is common to all actuarial practice areas, and ensures that students have mastered the fundamental concepts and principles before they begin to specialise. Since the Part 3 subjects can assume that students are already familiar with the ACC, duplication of content in Part 3 subject syllabuses is avoided. Further, having the ACC as a generic introduction to actuarial practice will make it easier in future to introduce additional specialist options in Part 3.

The ACC focuses the many strands of Part 1 of the education program on the work of an actuary. It brings together the apparently disparate, and not all specifically actuarial, elements of basic actuarial education and demonstrates their application to actuarial work in a range of traditional and non-traditional fields. Each element's relevance to the ACC is drawn out; for example, a solid grasp of the operations of a modern economy and the ability to read and interpret a set of financial statements are essential if the environment within which most actuarial work takes place is to be understood and accommodated.

The ACC concentrates on the principles and major concepts of actuarial work. It uses a simple model of actuarial work, shown in Figure 4 (Appendix 4), to help students develop an overview of actuarial practice. The model provides a common framework for identifying the nature and importance of such functions as risk identification, risk analysis, product design, pricing, profit testing, reserving, cash flow projection, asset/liability management, experience monitoring and analysis, analysis of surplus, solvency, and so on, within a range of practice areas. The practice areas studied include the traditional ones (life insurance, general insurance, superannuation and investment management), as well as emerging or potential (for Australian actuaries) fields like health insurance, banking, finance and long term care.

The ACC model is not new or revolutionary or even particularly actuarial; it is based on a simple general-purpose problem solving process (define the problem, then develop a solution, and then implement the solution and monitor the outcome), with in-built iterations incorporating feedback. The model has the great advantage of simplicity. It can be applied at many levels; for example, from the financial management of a large

corporation, to the design and implementation of a new product. Its role is educational, helping students to see what is common in actuarial work across practice areas, and to focus on principles and concepts. Students who are skilled at "seeing the big picture" are more likely to become actuaries who can adapt to new contexts and different problems.

The ACC takes a generic approach to actuarial work, proposing a general model which, more or less, fits all actuarial activity. Students are thus given the opportunity to develop a strong cognitive framework for "actuarial work" which is independent of any particular practice area. Armed with this framework, they can be expected to be more adaptive as actuaries. In particular, they will be able to approach new problems, new challenges and new application areas with a model of financial planning and control which is simple and flexible enough to be broadly applicable.

In the view of the author, students will benefit most from the ACC if they have some freedom to explore and develop their own concept of actuarial work within the broad general framework offered by the subject. Since the scope of the subject (ie actuarial work in existing, emerging and potential future application areas) is so wide, it is neither practicable nor desirable to expect all students to learn exactly the same knowledge and skills in exactly the same way to the same degree of detail. The subject lends itself perfectly to the use of learning contracts. Each student would negotiate a contract with the teacher, such contract setting out the student's learning goals, how the achievement of those goals may be recognised and evaluated, and what evidence will be produced for evaluation or assessment.

In the ACC subject, setting out to assess every student's learning by means of the same 3-hour unseen written examination amounts to stifling the opportunities for rich, high quality, durable learning that the subject promises.

Student portfolios

Portfolios of student work have been used for assessment purposes in some disciplines for a long time. Portfolios provide a natural approach to assessment in creative pursuits like architecture. However, portfolios could prove to be a valuable asset for students in actuarial programs.

A portfolio is a collection of artefacts - a collection of pieces of work by a student over a substantial period of time. For an actuarial student, a portfolio might include essays written, major assignments completed, documentation of models constructed, reports on data analysed, summaries of seminars presented, computer programs or spreadsheet models developed and copies of team reports resulting from group project work. A portfolio can also include reflective writing in which the student looks back on what she has learned, how she learned it and how it relates to her previous understanding and her own experiences of the real world. And, of course, a portfolio can be valuable to both teacher and learner for assessment purposes.

As well as their potential for promoting reflection and reflexivity, and their usefulness for assessment, portfolios will also serve students well when they begin job searching at the end of their university studies. Traditional employers of actuaries (eg insurance companies and actuarial or employee benefit consultants) may be satisfied with actuarial qualifications (eg university course or professional examination successes) as proof of employability. However, non-traditional employers of actuaries (eg banks, funds

managers, investment banks, etc) may not be as impressed by actuarial qualifications per se. An actuarial graduate who can produce a portfolio of her work and say, “*Look at this; this is what I can do!*”, is going to have a better chance of impressing an employer who is not in the habit of employing actuarial graduates than one who relies only on an academic record. Portfolios have the potential to assist actuarial graduates to compete for employment in the broader financial sector and even beyond.

Conclusion

Although the content of actuarial programs (ie the topics to be studied) is important, and can be, indeed has been to an increasing extent, designed to foster adaptability in tomorrow’s actuaries, other aspects of the curriculum are at least as important.

This paper has discussed three aspects of a university actuarial curriculum in the light of the need to develop adaptive actuaries :

- the implications of research on Australian actuarial students’ preferred learning styles;
- a new and pivotal subject in the Australian actuarial education program (*The Actuarial Control Cycle*);
- the use of student portfolios in actuarial education.

These three aspects may appear at first to be somewhat disparate, but there is a synergy between them. In particular, each points to the need for greater diversity in the teaching/learning activities and assessment methods used in actuarial education.

Each promises to broaden the perspective and the skills base of actuarial students beyond that which was possible when actuarial education was built on a limited base of the history, context, methods and approaches of the traditional practice areas. Furthermore, each aspect highlights the need for a richer mix of learning activities within university actuarial programs. Actuaries, like any other professional group, have always needed to be lifelong learners. Tomorrow’s actuaries will need to be lifelong flexible learners, able to adapt to the learning and problem solving demands of an ever-changing environment.

How actuarial students learn is probably more important than what they learn.

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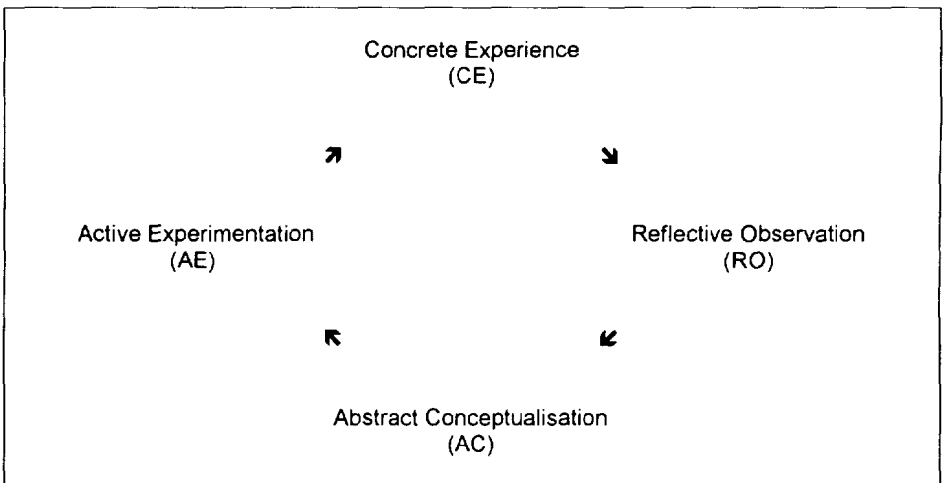
Appendix 1 : Kolb's Experiential Learning Model (ELM)

David Kolb's Experiential Learning Model (Kolb, 1981) represents learning as a cyclical process requiring each of four different stages or types of ability, or modes of learning - concrete experience abilities (CE), reflective observation abilities (RO), abstract conceptualisation abilities (AC) and active experimentation abilities (AE). Figure 1 shows how the four stages are conceived as part of a learning cycle, with each stage requiring different types of ability.

Learning begins with a concrete experience. The learner reflects on that experience. This reflection is accommodated cognitively by abstract conceptualisation or is generalised. The concept or generalisation is then tested for validity by active experimentation which of course results in further concrete experience as the process moves into another cycle.

The four stages can be represented simply as feeling (affective), watching (perceptual), thinking (symbolic), and doing (behavioural).

Figure 1 : The Experiential Learning Model (Kolb, 1981)

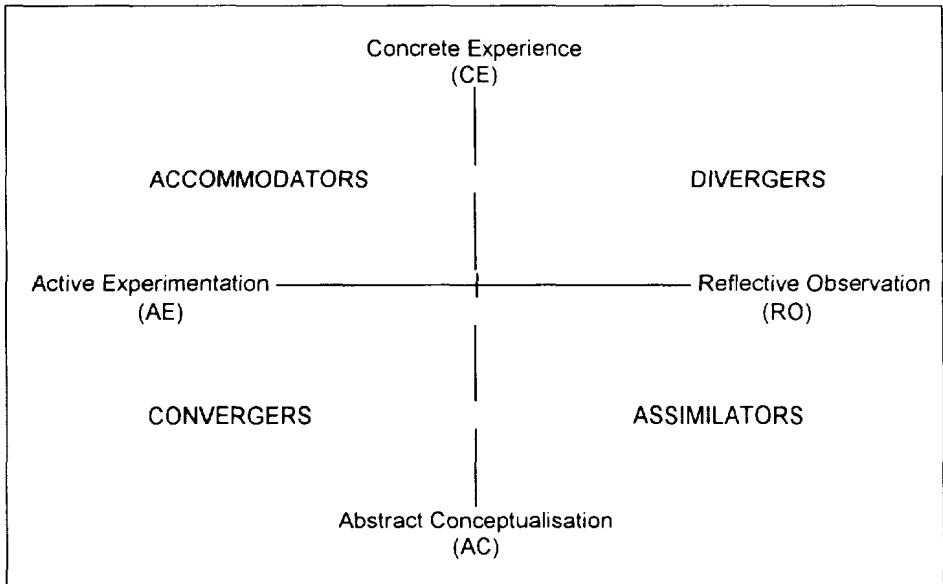


Appendix 2 : Kolb's Learning Style Types

Kolb's ELM model implies that "learning requires abilities that are polar opposites and that the learner, as a result, must continually choose which set of learning abilities he will bring to bear in any specific learning situation" (Kolb, 1976). Although learning requires all four types of ability, Kolb's learning style theory proposes that a particular learner may prefer and use one or more of the sets of abilities in preference to the others according to how effective and comfortable she feels with each stage when learning and/or solving problems. Individual personality characteristics and experience will influence preferences, which are expected to remain relatively stable if the learning environment remains so. Each person in a unique way develops a learning style which has both strong and weak points.

Kolb suggests further that learners can be categorised along two bipolar dimensions related to the Experiential Learning Model shown in Figure 2. The first dimension, represented by a "Concrete/Abstract" continuum (vertical axis), relates to how a learner perceives new information. Confronted by new situations or experiences, some people tend to sense and feel their way (CE), while others rely more on thought processes, using logic and ideas (AC). The second dimension, represented by an "Active/Reflective" continuum (horizontal axis), addresses how a learner processes new information. Some people like to get in and experience it, to learn by doing (AE), while others prefer to watch, listen and think it through first (RO).

Figure 2 : Kolb's Learning Style Types (Kolb, 1984)



Kolb's theory proposes that the extremes of each dimension are mutually exclusive. For example, one cannot simultaneously perceive by both concrete experience and abstract conceptualisation. To deal with this conflict, each individual must choose how to take in new information (and how to process it), and thus she develops preferences that together constitute a learning style - the characteristic way an individual tends to perceive and process new experiences.

Representing the two dimensions (Concrete/Abstract and Active/Reflective) by vertical and horizontal axes, as in Figure 2, produces a plane whose four quadrants, suggests Kolb (1984), represent four learning style types - divergers (who favour concrete experience and reflective observation), assimilators (who prefer reflective observation and abstract conceptualisation), convergers (who tend to use abstract conceptualisation and active experimentation) and accommodators (who lean towards active experimentation and concrete experience).

Divergers (CE+RO) have strong imaginative ability, and awareness of meaning and values. They can view situations from several perspectives, and perform well when alternative ideas and approaches are needed. They are interested in people and sensitive to interpersonal issues. This style has been found often in counsellors and personnel managers and in others with humanities or liberal arts backgrounds (Kolb, 1974).

Convergers (AC+AE) are "opposite" to divergers. Their strengths are problem solving, decision making and the practical application of ideas. They perform best in situations such as conventional intelligence tests where there is a single correct answer or solution to a problem. Their expression of emotion is controlled and they prefer to deal with technical tasks and problems rather than social and interpersonal issues. This style is characteristic of many engineers (Kolb, 1974).

Assimilators (RO+AC) prefer to use inductive reasoning in constructing theoretical models which assimilate disparate observations into an integrated explanation. Like convergers, they are interested in ideas and abstract concepts; but they are less concerned with the practical applications. This learning style is more characteristic of the basic than the applied sciences, and in industry is found most often in research and planning areas (Kolb, 1974).

Accommodators (AE+CE) have a learning style "opposite" to assimilators. They are people who are good at getting things done; they enjoy carrying out plans, tasks and experiments, and involving themselves in new experiences. They perform well in situations where adaptation to changing circumstances is required, and they solve problems intuitively, in a trial and error manner, relying on other people for information rather than on their own analytical ability. They may sometimes be seen as impatient and "pushy". They tend to have a practical or technical education (such as business administration) and are often found in "active-oriented" jobs like marketing or sales (Kolb, 1974).

Kolb (1984) suggests that an individual learner, influenced by experience, personality and environmental factors, will develop, over time, strengths and weaknesses that emphasise some learning styles over others. A personal balance will be found between being reflective and being active, and between perceiving the concrete and the abstract. Each dimensional balance can be represented by a point on the corresponding axis in Figure 2 (horizontal for active/reflective, and vertical for concrete/abstract). Thus an individual's learning style preference can be represented by a point on the plane formed by the two axes.

The intersection of the two axes (the origin) in Figure 2 then represents a balanced and, therefore, adaptive, learning style. An individual with a balanced preferred learning style is able to learn in a variety of environments. The further away an individual's preferred learning style is from the intersection (origin), the more heavily dominated their learning style is by one particular stage of the process. Such an individual will encounter some situations in which new knowledge is presented in a format or a way that is not consistent with their most developed learning stage abilities. Acquiring that new knowledge will then be difficult for that individual.

Appendix 3 : Australian Actuarial Education

Figure 3 : Structure of the Australian Actuarial Education Program

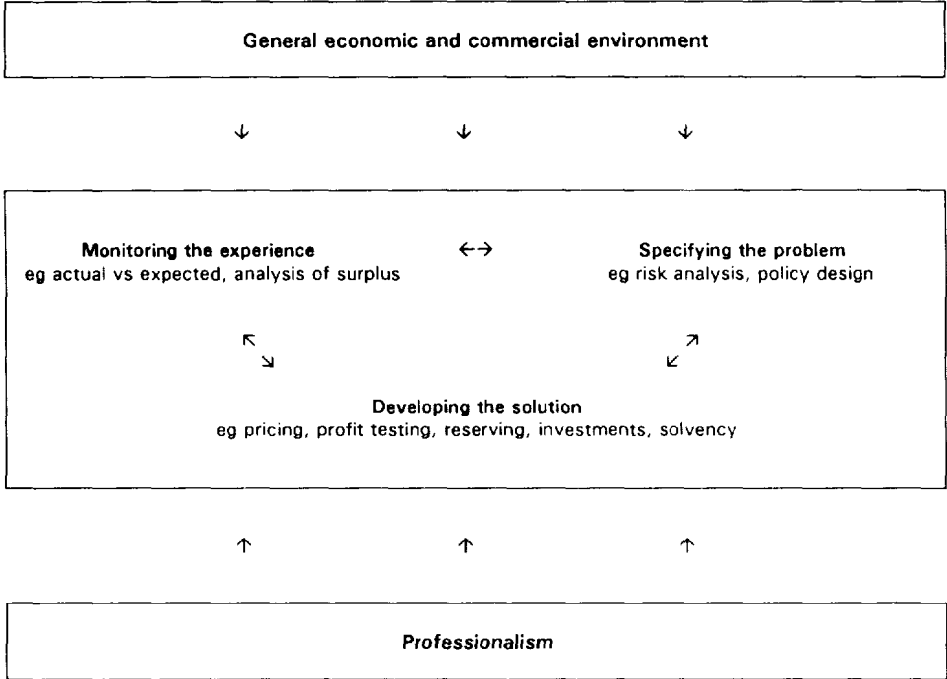
Part 1	Part 2	Part 3
Fundamental tools	ACTUARIAL CONTROL CYCLE	Specialist actuarial practice areas
Mathematics, statistics, actuarial mathematics, economics, computing, accounting, financial mathematics, etc.	General concepts and functions in actuarial work (eg risk analysis, pricing, reserving, solvency, monitoring experience, etc.) across established & emerging practice areas	Student selects any two of: <ul style="list-style-type: none"> • life insurance • general (P&C) insurance • superannuation (pensions) • investment management <ul style="list-style-type: none"> • finance
Available through accredited universities (3 years), or through UK exams	Available only through universities (1 year, by day, evening or distance mode)	Available only through exams conducted annually by IAA

Part 4
Professionalism Course
2-day intensive seminar, non-assessed, with high degree of student participation, conducted only by IAA

Note : IAA denotes Institute of Actuaries of Australia

Appendix 4 : The Actuarial Control Cycle (ACC) Model

Figure 4 : THE ACTUARIAL CONTROL CYCLE



Source : Shepherd (1997b), p 5