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Title: The development of early stage design cost estimating expertise: effective feedback and systematic reflection for quantity surveyors.

Abstract

The use of an effective feedback system influences the quality of early stage design cost estimates, for construction projects, prepared by consultant quantity surveyors. Similarly, a means of monitoring performance should be incorporated into any forecasting system. On an individual basis, systematic reflection is crucial for effective experiential learning and is held to be the only process through which a professional may achieve growth and self-renewal.

This paper reports, in part, on a fully structured interview survey of experienced quantity surveying practitioners and a questionnaire survey of student quantity surveyors, which investigate the application of effective feedback systems and systematic reflection by early stage design cost estimators.

The results indicate that, despite the recommendations of previous studies, many QS practitioners still have inadequate feedback systems. Many either do not systematically reflect on the outcomes of estimates, or use self-assessment as the sole means of evaluation. Also, the QS practitioner sample had significantly lower Reflective Observation learning style scores when compared to the student survey sample, while their declared approach to learning exhibited an aversion for self-assessment or self-appraisal. Finally, on an organisational basis both practitioners and student quantity surveyors gave a low rating to the provision of constructive feedback by the organisation on their performance.

Keywords: design cost estimating, experiential learning, feedback systems, quantity surveyors, systematic reflection

INTRODUCTION

Ashworth and Skitmore (1983) state that the main factor in accurately predicting construction costs is knowledge of general price levels, and that such knowledge is predominantly

acquired through experience and other subjective attributes. Similarly, Oteifa and Baldwin (1991) conclude that the single most important factor in the production of any accurate estimate is an estimator's experience and expertise. Further, Morrison and Stevens (1980) and Ogunlana (1989) have also illustrated the perceived importance of the estimator's experience within the quantity surveying profession. Experience is, therefore, considered by far the most important factor affecting the performance of early stage design cost estimators. It is believed to be acquired over time and has been associated with the development of knowledge (Skitmore, 1987), familiarity (Morrison, 1984), feedback (Flanagan and Norman, 1983), professional judgement (Flanagan *et al.*, 1989) and estimating expertise (Skitmore *et al.*, 1990).

Experiential learning is the method by which individual's process experience. Further, learning from experience really means learning from reflection on experience (Boreham, 1987) and the evaluation of experience is important to effective learning (Boud *et al.*, 1985). However, Ogunlana (1989) found that quantity surveyors were failing to learn from experience, while Beeston (1983) maintained that few practitioners objectively measure their estimating performance. This paper, therefore, examines the application of effective feedback systems and systematic reflection by early stage design cost estimators.

Learning from experience

Further research into the influence of experience on estimating performance has been suggested in order to improve the selection, manipulation and application of costs (Morrison and Stevens, 1980) and into improving learning from experience (Ogunlana, 1989). Ogunlana (1989) states:

“... the development of individual expertise in cost estimating seems a viable option for improving estimating performance. Research into the qualities in the individual that tend to make them better estimators is necessary to determine how such qualities can be recognised in people, how they can be developed and what method of training will best enhance these qualities in individuals”.

Ogunlana (1989) found that design estimators are not learning adequately from experience,

that there is an illusion of validity and that failure to learn originates from the lack of a system for monitoring estimating performance. He recommended the incorporation of feedback techniques as representing a potential force for improving accuracy. In the short term, Ogunlana (1991) suggests that design offices will be required to set up formal systems for self-evaluation that promote learning through constructive use of process and outcome feedback.

The feedback system

The use of an effective feedback system is considered to influence the quality of estimates (Skitmore *et al.*, 1990) by providing information on the accuracy of previous forecasts (Flanagan and Norman, 1983) and by providing more accurate rates for current estimates (Skitmore, 1990). Similarly, Morrison (1984) suggested that:

“... the achievement of an increase in accuracy is dependent upon the means by which knowledge and experience gained on previous projects is related to future work. In those offices where an improved performance was detected, it was noticeable that either a central library of information or an index system by which the quantity surveyors could familiarise themselves with the data at their disposal had been constructed”.

Raftery (1991), when considering what should be included in a simple forecasting system, highlights, amongst others, a method of allowing human judgement where personnel are held accountable for any interventions they make and a means of monitoring the performance of the forecasting system. In order to increase the awareness of bias within estimating, Raftery (1994) suggests the introduction of procedures that incorporate feedback loops into the filing of estimates and forecasts, the fostering of a culture of estimating and forecasting, which centres on explicitly dealing with risk and uncertainties, and that accepts that some forecasts will prove to be inadequate. Procter *et al.* (1993), also, recommend the introduction of feedback mechanisms to establish the levels of satisfaction with 'pro-active interaction' between the providers and users of the price advice to ensure that maximum benefit is obtained by the latter.

Skitmore (1985) states that:

“... the foundation of knowledge and experience has been repeatedly confirmed by reference to knowledge of the database and experience of similar work reinforced by feedback from a sufficient amount of projects”.

The application of experiential factors seems to be enhanced where suitable feedback systems are in operation. Investigations have, however, revealed that few early stage design cost estimators objectively measure their estimating performance (Beeston 1983). Flanagan and Norman, 1983 recommend that:

“... there is a need for estimating performance to be monitored consistently. The custom in the building industry appears often to have been to take the forecast, as being 'correct' and the tenders, when they differ from the forecast, as being 'wrong'”.

Experiential learning

Eraut (1994) concludes that learning from experience is extremely important in professional development, and requires an ability to conceptualise and an ability to evaluate. Further, it is important for professionals to sustain a critical and evaluative attitude towards practice, so that they seek to improve it and do not lapse into complacency.

Kolb (1984) proposes a model of experiential learning, which comprises the cycle of concrete experience, observation and reflection, formulation of abstract concepts and generalisations and testing implications of concepts in new situations (See Figure 1). He defines learning as: *“... the process whereby knowledge is created through the transformation of experience”* and occurs *“... through the active extension and grounding of ideas and experience in the external world and through internal reflection about the attributes of these experiences and ideas”*. Further, Boreham (1987) comments that the term 'learning from experience' really means learning from reflection on experience.

<<<< Insert figure 1 here >>>>

Reflection

Boud *et al.* (1985) define reflection as a form of response of the learner to experiences: “... *a generic term for those intellectual and affective activities in which individuals engage to explore their experiences in order to lead to new understandings and appreciations*”.

Reflection both in terms of a form of deliberation and metacognition are important contributors to professional expertise, however, most expert performance is on going and non-reflective (Eraut, 1994). According to Schön (1987): “... *the only way that a professional person may achieve growth and self-renewal is through some process of systematic reflection*”. Most models of experiential learning assume that reflection will happen, but the application of reflection will depend on the disposition of the learner (Eraut, 1994).

“*The capacity to reflect is developed to different stages in different people and it may be this ability which characterises those who learn effectively from experience*” (Boud *et al.*, 1985). According to Duley (1981), however: “... *the skill of experiential learning in which people tend to be most deficient is reflection*”. Also, the professional’s environment will probably include barriers to the effective reception of feedback (Boreham, 1987). “*Deliberation is unlikely to occur in the workplace unless the professional(s) concerned build deliberate time into their performance periods*” (Eraut, 1994).

Eraut (1994) comments that: “... *self-knowledge of performance is difficult to acquire, and self-comment tends to be justificatory rather than critical in intent*”. Similarly, Schön (1983) believes that: “... *many practitioners, locked into a view of themselves as technical experts, find nothing in the world of practice to occasion reflection... for them, uncertainty is a threat; its admission is a sign of weakness*”. Likewise, people have a tendency to seek information to confirm their ideas rather than to look for possible disconfirming evidence and positive feedback is weighed more heavily in memory than negative feedback (Hogarth, 1987).

Gibbs (1988) suggests that log books, diaries, video and audio recordings, peer appraisal, structured discussions, structured debriefing, self-assessment, reflection check-lists and questionnaires are helpful in assisting learners to reflect on their experiences. Further ways of enhancing reflection include portfolios, journals and collaboration.

Feldman (1986) considers that: “... *the environment strongly influences the degree to which useful feedback is available*”. Mumford (1986) presents an organisational culture climate approach, in which an organisation encourages learning if: it encourages managers to identify their own learning needs and sets challenging learning goals; it encourages managers to experiment; it provides opportunities for learning both on and off the job; it gives on-the-spot feedback; it allows time for managers to review, conclude and plan learning activities, and it tolerates some mistakes, provided managers try to learn from them.

The paper, therefore, investigates the mechanisms by which practitioners obtain feedback on their estimating performance, their predisposition to reflect on their performance and the influence of the organisation within which they work in providing feedback on their estimating performance. Further it seeks to establish relationships between these factors and differences between sub-groups based on their method of reflecting on the outcomes of estimates.

Methodology

Data was, therefore, required to establish:

- How individuals reflect on the outcomes of estimates (their feedback mechanisms);
- The individuals propensity to reflection, in terms of their approaches to and style of learning; and
- The organisation’s support of individual learning, in terms of providing feedback on an individual’s estimating performance.

The data collection was divided into two distinct parts: For Part One the sample group represented experienced quantity surveying practitioners and the Part Two sample represented novice quantity surveyors (on the assumption that university students would be representative of this group).

Samples

Part One:

The population for the investigation was experienced early-stage construction price forecasters (quantity surveyors) based within Greater Manchester, central Lancashire and south Lakeland. The area of study was selected as representative of North West England. It was believed that the area represented a relatively homogeneous group. Ultimately, 84 practitioners from 77 practices took part. This represents 45% of the target organisations.

Part Two:

The population for the novice quantity surveyor was students enrolled into full-time and part-time built environment courses at five institutions of higher education located within the North West. The sample comprised 63 students (19%) on full-time sub-degree programmes, 131 students (39.6%) on full-time BSc degree programmes and 137 students (29.5%) on a part-time BSc degree programmes in Quantity Surveying.

Surveys

Part One:

This stage of the investigation adopted a fully structured (face-to-face) interview survey, which, in part, required the practitioner interviewees to complete a multi-sectional questionnaire. The questionnaire survey instrument comprised:

- an experience profile, which provided information concerning the position of the subject within their organisation, their estimating experience, performance and practice;
- a revised randomised version of Kolb's (1985) Learning Style Inventory (LSI - 1985);
- an approaches to learning at work questionnaire (ALQ); and
- a learning climate questionnaire (LCQ), an inventory designed to elicit information on whether the subjects considered their organisation provided an appropriate climate.

The original scoring method of Kolb's LSI - 1985 was replaced by a four-point agreement scale. The rationale for this was to remove the ipsative nature of the inventory. The choice of a four-point scale was dictated by a desire to force a choice between agreement/disagreement

with each item. The ALQ required the subjects to rate the strength of their agreement to twenty-four items on a five-point agreement scale. The items were derived from:

- Kolb *et al's* guide for analysis of personal problem solving processes (Kolb *et al.* 1979); Kolb's adaptive competencies and work abilities (Kolb 1984);
- Mumford's skills involved in effective learning behaviour and the rational approach to learning (Mumford 1980);
- Honey and Mumford's knowledge and skills items and abilities of the ideal learner (Honey and Mumford 1989);
- Richardson's Approaches to studying questionnaire (Richardson 1990);
- Smith's post project analysis form (Smith 1982); and
- Gibbs' abilities associated with each stage of the learning cycle (Gibbs 1988).

The LCQ required the subjects to rate fifteen pairs of statements on a five-point semantic differential scale. The chosen statements were derived from:

- Pedler *et al's* (1991) measuring the quality of your learning climate;
- Honey and Mumford's (1989) work situation items; and
- Mumford's (1980) ways in which supervisors can improve the learning climate.

Part Two:

Two separate questionnaires were administered, depending on the mode of study (part-time or full-time) of the students. Questionnaire 1, administered to part-time students, contained the revised version of Kolb's LSI - 1985, the LCQ, details of the student's year of study and category of employment. Questionnaire 2, administered to full-time students, contained the revised LSI - 1985, the ALQ and details of the student's year of study.

Analysis

Descriptive statistics were produced for the questions relating to estimating procedures. The mean and standard deviation were calculated for each subscale of Kolb's revised LSI – 1985, which were then also analysed for differences between the practitioner and student samples using the Mann-Whitney U/Wilcoxon Rank Sum W Test.

Descriptive statistics were calculated for each item of the ALQ, which were then ranked

based on the mode item score. Each item of the ALQ was analysed for differences, by means of the Wilcoxon signed ranks test between the practitioner responses and the mode/median response, the Mann-Whitney U/Wilcoxon Rank Sum W test between the practitioner and student samples and the Kurskal-Wallis one-way ANOVA test between subgroups based on the practitioner's method of reflecting on the outcomes of estimates.

Descriptive statistics were calculated for each item of the LCQ, which were then ranked based on the mode item score. Each item of the LCQ was analysed for differences, by means of the Wilcoxon signed ranks test between the practitioner responses and the mode/median response and the Mann-Whitney U/Wilcoxon Rank Sum W test between the practitioner and student samples. Finally the items of the ALQ were correlated with the items of the LCQ.

FINDINGS

Feedback systems

The responses revealed that 70 practitioner respondents (83.3% of the sample) had estimating procedures that *positively encourage systematic reflection on the outcomes of estimates*, while 14 (16.7%) had no such procedures. Those that stated they had estimating procedures that positively encourage systematic reflection on the outcomes of estimates responded as follows:

- The most common response was self assessment with 32 practitioners (45.7%) indicating using it as their sole means of evaluation;
- The second most popular method was a combination of peer and self assessment with 14 respondents (20%) using this combination;
- Nine surveyors (12.9%) indicated the use of a combination of self assessment with some other method other than peer appraisal; while
- Five surveyors (7.1%) indicated the use of a combination of peer and self-assessment with a further method.
- The sole use of peer appraisal was indicated by five interviewees (7.1%); while

- Two surveyors used a combination of peer appraisal and a further method.
- Only two interviewees used diaries and these were in association with either peer or self-assessment.
- Only two respondents indicated the use of logbooks, again, these were used in combination with self-assessment.
- Finally, interviewees also indicated the use of formal and informal cost analysis, compiling databases either individually or as an organisation, quality management systems and discussion/review with colleagues.

If the practitioners had indicated they had no procedures that positively encouraged systematic reflection on the outcomes of estimates, they were asked how they did reflect on their estimating performance, if at all.

Responses to this question revealed:

- “performance review on a job by job basis, i.e. only when tenders are high”,
- “time constraints rarely allow time for reflection etc.”,
- “client judgement and satisfaction”,
- “use as a guide for next time”,
- “mental comparison with tenders”,
- “close to lowest tender”, and
- one interviewee made no comment.

When asked what would or does prompt them to review their estimating practice:

- 87% of the practitioners suggested a desire to continually improve,
- 70% client and self dissatisfaction, and
- 67% new opportunities.

The results would suggest that quantity surveyors consider themselves to be proactive as well as reactive. Pressure of work, feeling harassed and short of time were suggested as the main barriers to changing or questioning estimating performance. This finding is in accord with Houle (1980) who states that the major self-perceived barrier to learning for professionals is insufficient time. Overall, however, 62% of the sample considered that they were unlikely to change or experiment with the way they prepared estimates within the next twelve months.

Individual Learning Styles

The order of preference of the LSI - 1985 learning style subscales for both the practitioner and student samples were:

- Active Experimentation (AE),
- Abstract Conceptualisation (AC),
- Reflective Observation (RO), and
- Concrete Experience (CE)

based on the descending order of mean subscale scores. The means and standard deviations for the LSI subscales are presented in Table 1.

<<<< Insert table 1 here >>>>

Tests for differences indicated that the practitioners prefer an active and analytical learning style, represented by Active Experimentation and Abstract Conceptualisation rather than a reflective style, represented by learning by Reflective Observation. For Concrete Experience and Abstract Conceptualisation the scores for the practitioners were significantly higher than those of the students, while the Reflective Observation scores for the practitioners were significantly lower than those of the students.

Approaches to Learning

There was general agreement between the student and practitioner samples in the rank order of the approaches to learning items based upon the mode item score.

The results indicated a preference for an open and collaborative approach to learning, represented by high ratings for:

- “I can accept help from others”;
- “I am open to new angles and possibilities”; and
- “I make a conscious effort to learn from experience”.

They also suggested a reluctance for self-assessment or self-appraisal, represented by the relatively low rating of:

- “I regularly assess my own development needs”,
- “I often take time to review my performance”; and
- “I ask for feedback on my performance”

ranked 18th, 19th and 24th out of 24 respectively by the practitioners (Table 2) and 18th, 20th and 24th by the students. Further, the Wilcoxon signed ranks test between the practitioner’s responses to these items and the mode/median response revealed that all were significantly lower than the mode/median response (all significant at the 0.001 level). The Mann-Whitney U/Wilcoxon W rank sum test revealed no significant difference between the responses by the practitioners (n = 84) and part-time students (n = 194) for the items “I ask for feedback on my performance” and “I regularly assess my own development needs”. However, for the item “I often take time to review my performance” the practitioners’ score was significantly higher than that of the students (significant at the 0.05 level). The low rating of self-assessment may be linked to individuals acquiring a vested interest in not noticing their inadequacies. Heron (1985) refers to this as falsification, while Eraut (1994) comments that “... *self-knowledge of performance is difficult to acquire, and self-comment tends to be justificatory rather than critical in intent*”.

<<<< Insert Table 2 here >>>>

The QS practitioner’s responses to items 1, 13 and 17 (See Table 2) were tested for differences between sub- groups based on their method of reflecting on the outcomes of estimates. These sub-groups comprised:

- Group A - those who used peer appraisal and combinations of methods (n = 36);
- Group B - those who used self-assessment and other single responses (n = 34); and
- Group C - those who had indicated they did not systematically reflect on the outcomes of estimates (n = 14).

The Kurskal-Wallis one-way ANOVA test revealed no significant differences between these groups in responses for the items “I regularly assess my own development needs” and “I often take time to review my performance”. It did, however, reveal a significant difference in the responses to the item “I ask for feedback on my performance” (significant at the 0.05 level). Further investigation revealed that the responses for groups A and B were both

significantly higher than for group C - those who had indicated they did not systematically reflect on the outcomes of estimates.

As previously stated, systematic reflection is considered crucial for effective experiential learning, for example, Eraut (1994) considers it to be an important contributor to professional expertise. The results are, however, in keeping with Casey (1983) who suggests that the regular opportunity to pause and reflect before having another go is not necessarily present in a manager's working life and Eraut (1994) who states that most expert performance is on-going and non-reflective.

The Learning Climate

The individual items of the LCQ were ranked based on the mode response. The results suggest that the working environment was less than supportive in the provision of constructive feedback on performance and the identification of development needs. The items “Constructive feedback is often provided about your performance” and “There is a systematic process for identifying individual development needs” were ranked 13th and 15th out of 15 items respectively by the practitioners (Table 3) and ranked 13th and 14th by the students. Further, the Wilcoxon signed ranks test between the practitioners’ responses to these items and the mode/median response revealed that both were significantly lower than the mode/median response (significant at the 0.001 level). The Mann-Whitney U/Wilcoxon W test revealed that the practitioners’ score was significantly higher than that of the students for both “Constructive feedback is often provided about your performance” and “There is a systematic process for identifying individual development needs” (significant at the 0.001 and 0.05 level respectively).

<<<< Insert table 3 here >>>>

The practitioner’s responses to items 3 and 9 were tested for differences between sub- groups based on their method of reflecting on the outcomes of estimates. The Kurskal-Wallis one-way ANOVA test revealed no significant differences in the responses for either item.

Despite the recommendations of Flanagan and Norman (1983), Morrison (1984) and Lowe, D J (2003) The development of early stage cost estimating expertise: effective feedback and systematic reflection for quantity surveyors. *Journal of Financial Management of Property and Construction*, 8(2), 79-88, eScholarID:1a3088

Ogunlana (1989) that design offices should introduce formal feedback systems, it would appear from the low ratings given to a systematic process for identifying individual development needs within organisations and to the provision of constructive feedback that many surveying organisations still have to implement this suggestion. This may be systematic of the lack of self-reflection and self-assessment within the individual. The item “Constructive feedback is often provided about your performance” correlates significantly and positively with “I ask for feedback on my performance” (Spearman’s rho = 0.334, significant at the 0.002 level) and “I regularly assess my own development needs” (Spearman’s rho = 0.306, significant at the 0.005 level).

Conclusions

Systematic reflection is considered crucial for effective experiential learning, for example, Schön (1987) suggests that it is only through some process of systematic reflection that a professional may achieve growth and self-renewal. On an individual basis, however, many practitioners either did not systematically reflect on the outcomes of estimates, or used self-assessment as the sole means of evaluation. Moreover, only four practitioners used diaries or logbooks to aid reflection despite them being considered helpful in aiding reflection on experiences (Gibbs, 1988). Also, the practitioners had significantly lower Reflective Observation learning style scores when compared to the student sample, while their declared approach to learning exhibited an aversion for self-assessment or self-appraisal. On an organisational basis both practitioners and part-time students gave a low rating to the provision of constructive feedback by the organisation on their performance. The results, however, are in keeping with Beeston (1983) who maintained that few practitioners objectively measure their estimating accuracy, Ogunlana (1989) who found an absence of a system requiring regular monitoring of estimating performance, and Duley (1981) who considers reflection to be the skill that most people lack. The results lead to the conclusion that, despite the recommendations of Flanagan and Norman (1983), Morrison (1984), and Ogunlana (1989), many practitioners still have inadequate feedback systems on their estimating performance. It is suggested that quantity surveying organisations should introduce effective feedback mechanisms that require individual staff to critically reflect on their estimating performance, and the organisation should provide effective constructive

feedback on each individual's estimating performance.

References

- Ashworth, A. and Skitmore, R.M. (1983) Accuracy in Estimating. *C.I.O.B. Occasional Paper*, 27, Englemere
- Beeston, D.T. (1983) *Statistical Methods for Building Price Data*, E & FN Spon, London
- Boreham, N.C. (1987) *Learning from Experience in Diagnostic Problem Solving*, in *Student Learning: Research in Education and Cognitive Psychology*. (edited by J.T.E Richardson, M.W. Eysenck and D. Warren Piper) The Society for Research into Higher Education and Open University Press, Buckingham
- Boud, D., Keogh, R. and Walker, D. (1985) *Promoting Reflection in Learning - a Model*, in *Reflection: Turning Experience into Learning* (edited by D. Boud, R. Keogh and D. Walker) Kogan - Page, London
- Casey, D. (1983) *Where action Learning fits in*, in *Action Learning in Practice* (edited by M. Pedler) Gower, Aldershot
- Duley, J.S. (1981) *Field experience education*, in *The Modern American College* (edited by A.W. Chickering) Jossey-Bass, San Francisco
- Eraut, M. (1994) *Developing Professional Knowledge and Competence*, The Falmer Press, London
- Feldman, J. (1986) *On the Difficulty of Learning from Experience*, in *The thinking Organisation* (edited by H.P. Sims, D.A. Gioia and Associates) Dynamics of Organisational Social Cognition, Jossey Bass, San Francisco
- Flanagan, R. and Norman, G. (1983) The accuracy and monitoring of quantity surveyors' price forecasting for building work. *Construction Management and Economics*, 1 (2), 157- 180
- Flanagan, R., Norman, G., Meadows, J., and Robinson, G. (1989) *Life Cycle Costing Theory and Practice*, BSP Professional Books, Oxford
- Gibbs, G. (1988) *Learning by doing - A guide to teaching and learning methods*, F.E.U.
- Hogarth, R.M. (1987) *Judgement and Choice - The Psychology of Decision* 2nd edn, John Wiley and Sons, Chichester
- Houle, C.O. (1980) *Continuing Learning in the Professions*, Jossey Bass, San Francisco

- Kolb, D.A. (1984) *Experiential Learning: Experience as the Source of Learning and Development*, Prentice - Hall, New Jersey
- Kolb, D.A. (1985) *Learning Style Inventory: Technical Manual* revised edn, McBer & Co., Boston, Mass.
- Morrison, N. (1984) The accuracy of quantity surveyors cost estimating. *Construction Management and Economics*, **2** (1), 57-75
- Morrison, N. and Stevens, S. (1980) *Construction Cost Data Base* 2nd annual report of research project by Department of Construction Management, University of Reading, for Property Services Agency, Directorate of Quantity Surveying, DOE
- Mumford, A. (1986) Learning to Learn for Managers. *Journal of European Industrial Training*, **10** (2), 1 - 28
- Ogunlana, S.O. (1991) Learning from experience in design cost estimating. *Construction Management and Economics*, **9** (3), 133-150
- Ogunlana, S.O. (1989) *Accuracy in Design Cost Estimating*, PhD thesis, Loughborough University of Technology
- Oteifa, S.A. and Baldwin, A. (1990) Modelling Civil Engineering Estimators' Expertise, Proceedings of the Association of Researchers in Construction Management (ARCOM) 6th Annual Conference, University of Salford, 7th September 1990, pp 160-169
- Procter, C.J., Bowen, P.A., Le Roux, G.K., Fielding, M.J. (1993) "Client and architect satisfaction with building price advice: an empirical study" *Proceedings of CIB W-55 International Symposium on 'Economic Evaluation and the Built Environment'*, Lisbon, September 1993, **4**, 213-225
- Raftery, J. (1994) Human aspects of project risk management *Proceedings of CIB W92 Symposium, East meets West: Procurement Systems, Hong Kong, 4-7th December 1994*, 277-285
- Raftery, J. (1991) *Principles of Building Economics*, BSP Professional Books, Oxford
- Schön, D.A. (1983) *The Reflective Practitioner - How Professionals Think in Action* Temple Smith, London
- Schön, D.A. (1987) *Educating the Reflective Practitioner: Towards a New Design for Teaching and Learning in the Professions*, Jossey-Bass, San Francisco

- Skitmore, R.M. (1990) Which Estimating Technique, *Transactions AFTITEP 6th Annual Meeting, Paris France, Proceedings of the eleventh international cost engineering congress*. B1.1- B1.4
- Skitmore, R.M. (1985) *The Influence of Professional Expertise in Construction Price Forecasting*, Salford University
- Skitmore, R.M. (1987) *The effect of project information on the accuracy of building price forecasts* in *Building Cost Modelling and Computers*. (edited by P.S. Brandon) E and FN Spon, London
- Skitmore, R.M., Stradling, S., Tuohy, A. and Mkwezalamba, H. (1990) *The Accuracy of Construction Price Forecasts*, Salford University

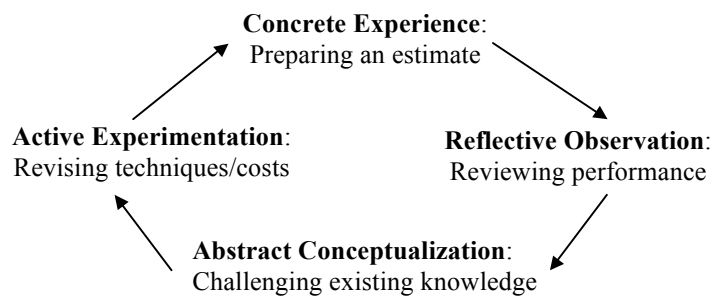


Figure 1: Kolb's (1984) experiential learning cycle applied to the estimating process

Table 1: Means, standard deviations and tests for differences for Kolb's Learning Style Inventory - 1985 revised Subscale Scores

Sample	n		CE	RO	AC	AE	AC-CE	AE-RO
Practitioners	84	Mean	32.43	32.86	36.82	40.49	4.39	7.63
		SD	4.61	6.57	4.85	4.40	5.21	6.85
Students	326	Mean	30.92	34.33	35.51	39.97	4.59	5.64
		SD	5.20	5.79	5.53	5.23	6.13	7.16
Practitioners/ Students	84 326	't' ₁	2.42*	-2.02*	1.99*	0.84	-0.27	2.29*
		't' ₂	-2.13*	-1.91	-1.80*	-0.53	-0.46	-2.35*

NB: *= $p \leq 0.05$; 't'₁ = t-test for Independent Samples, 't'₂ = Mann-Whitney U – Wilcoxon Rank Sum W Test.

Table 2: Ranking of Individual Items of Approaches to Learning Questionnaire based on mode (Practitioners, n = 84)

Rank	Item	Disagree					Agree					Median	Z Score 1	Z Score 2
		0	1	2	3	4	0	1	2	3	4			
18	1	I often take time to review my performance										3	-4.078***	-2.144*
19	13	I regularly assess my own development needs										2	-5.633***	-0.831
24	17	I ask for feedback on my performance										2	-4.607***	-1.215

NB: Mode = bold; * = $p \leq 0.05$; ** = $p \leq 0.01$; *** = $p \leq 0.001$; Z Score 1 = Wilcoxon Signed Rank Test between practitioner/median responses; Z Score 2 = Mann-Whitney U – Wilcoxon Rank Sum W Test between practitioner/student responses

Table 3: Ranking of Individual Statements of Learning Climate Questionnaire based on mode (Practitioners, n = 84)

Rank	Item	0	1	2	3	4	Median	Z Score 1	Z score 2	
13	Q9	2	15	33	27	7	Constructive feedback is often provided about your performance	2	-5.684***	-2.990**
							Constructive feedback is rarely provided about your performance			

15	Q3	The identification of development needs is left to the individual	7	26	24	20	7	There is a systematic process for identifying individual development needs	2	-6.349***	-2.290*
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NB: Bold = Mode; * = $p \leq 0.05$; ** = $p \leq 0.01$; *** = $p \leq 0.001$; Z Score 1 = Wilcoxon Signed Rank Test between practitioner/median responses; Z Score 2 = Mann-Whitney U – Wilcoxon Rank Sum W Test between practitioner/student response