

TRAINING FOR MASTERY IN SECONDARY VOCATIONAL EDUCATION

by

D.G. Crawford Ph.D.

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Canadian Vocational Association P. O. Box 3435, Station D Ottawa, Ontario K1P 6L4

Tel: (613) 727-0532

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BIOGRAPHICAL SKETCH

DOUG CRAWFORD, Ph.D.

Born and raised in Vancouver, B.C., Dr. Crawford earned his BA and MA in psychology at the University of B.C.: he practiced as a clinical psychologist for a number of years. He then shifted his interests to education, and taught grades 7 - 10 in Burnaby, B.C. Dr. Crawford then earned his PhD in Educational Theory at the University of Toronto, where he taught graduate students at the Ontario Institute for Studies in Education and at the Faculty of Education focusing on instructional psychology, instructional technology and instructional systems. He moved back West in 1973 to assist in the establishment of Athabasca University in Edmonton. Most of his time in Edmonton, however, was spent as Director, Learning Systems Branch, Alberta Advanced Education.

Dr. Crawford retired from government in 1987, and returned to Athabasca University as Director of the Training for Improved Performance (TIP) project - a three-year initiative co-sponsored by Employment and Immigration Canada (Canadian Jobs Strategy) and the University. The TIP project, which terminated in February, 1990, was designed to apply systems concepts to training in business, industry and the public sector. Dr. Crawford is now a training and education consultant in the Edmonton area.

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INTRODUCTION

The theme of the Canadian Vocational Association's 25th Annual Conference in Toronto, June 11 - 14, 1989 was "Renewing Canada's Skills Base". The Conference announcement stated that "Canada faces a skilled labour crises ... (and) unless we can find ways to better develop and utilize our human resources, our economy and our standard of living will inevitably decline relative to our international competitors". Citing an excerpt from the Globe and Mail of January 23, 1989, the announcement began:

"Canadian businesses, increasingly running into production difficulties because they cannot find enough skilled employees, can expect the problem to get worse in the 1990's unless education and training policies change. That's the conclusion reached by the Canadian Labour Market and Productivity Centre in its latest quarterly review... There is an overwhelming case for making training and education a priority in addressing current labour-market problems..."

A similar focus on improving our education/training system was contained in the Report of the Advisory Council on Adjustment. The Council stated that although skill requirements are becoming more sophisticated as Canada is now well into the "information age", "... significant segments of the Canadian population are not equipped to meet the challenge this change represents" (de Grandpré, 1989, p.

28). Citing a number of worrisome statistics about the lack of basic skills and competencies of our adults and recent high school graduates, the Council recommends that:

"On an urgent basis, the first ministers find the appropriate vehicle to review the education/training systems in order to increase their responsiveness to the requirements of rapidly changing international and domestic economies. Such a vehicle should involve participation by both business and labour, and might take the form of a federal-provincial royal commission on education/training" (de Grandpré, 1989, p. 33).

A critical component of Canada's education and training is the system of technical vocational secondary schools. Focusing specifically on secondary vocational education, Glendenning (1989) identified a number of critical issues that require attention since "... many educators, academic and vocational, are concerned about its survival and more importantly, the negative impact its demise would have on the education of our young people". Twelve issues were identified as requiring attention, ranging from the definition of the term vocational education and its image, through issues pertaining to the nature of its curriculum, requirements for graduation, type of staffing and certification, and the administration and organization of schools.

Similar themes emerged in a recent review of vocational education in Alberta. While it was not the purpose of this paper to examine provincial responses to the kinds of issues facing secondary vocational education in Canada, the Alberta review exemplifies a provincial response to the kind of issues identified by Glendenning and the Advisory Council, and provides a context for the proposal which is the focus of this paper.

A synopsis of some of the trends and issues identified by Alberta Education suggests that new forms of schooling are needed; that some students require more time and patience, and more novel and different ways of teaching; that changes in the curriculum are required since students perceive that the curriculum itself leads to dropping out of school; that clarity of linkages between school and work are needed to support school projects; and that findings from major breakthroughs in instructional theory should guide both curriculum design and implementation of the practical arts (Alberta Education, May 1989, pp. 22 - 32). The document lists a host of challenges posed by the above, including:

- (a) establishing appropriate uses of technology and learning resources to improve the quality of and access to learning in the practical arts;
- (b) determining strategies to allow practical arts teachers to design programs based on the level of student competency (e.g., challenge exams, waiver of prerequisites, provision for greater entry and exit points);
- (c) assessing the degree to which individualization is feasible;
- (d) developing suitable instructional materials for students and teachers;
- (e) defining how basic academic skills (mathematics, science, language arts) can be reinforced within the practical arts and extend practical skills for wider applicability;
- (f) providing information on the linkages between courses and occupations;

- (g) considering strategies to expand access to programs (e.g., advancement by competency);
- (h) defining innovative curricular and delivery alternatives for practical arts;
- (i) increasing business/industry's understanding about learning outcomes expected in practical arts courses (develop more open channels of communication);
- (j) establishing sequences and strategies to reinforce basic skills and resource use;
- (k) encouraging strategies that teach more "methods and procedure" than just "discovery and testing"; and
- (I) reinforcing opportunities to combine a variety of learning modalties to achieve required goals (learning outcomes) (Alberta Education, May, 1989, pp 45 48).

Another Alberta report outlined programs and courses in a few schools which are exploring adaptations and changes in the curricula and delivery system (Alberta Education, 1989 (a). A third report proposed directions for change in the practical arts programs in Alberta, including scenarios for supporting alternate strategies for program delivery and a modularized competency-based curriculum (Alberta Education, 1989, (b), p. 21). The same report correctly noted that successful implementation of the directions for change outlined would require the cooperative efforts of "... Alberta Education, school systems, schools, teachers and counsellors, other government departments, business/industry, and community members" (p 28).

In what follows, a new model or paradigm for technical vocational training at the high school level is proposed. The new model is designed to address many of the trends, issues and challenges referred to above. To do so, it will pose an alternative to the structure, organization, management and delivery of instruction associated with the traditional secondary technical vocational grade school. It proposes a new way of delivering secondary vocational training that could be more effective, efficient and feasible - for students, instructors, business/industry and the community. What is argued is that Canada needs a new paradigm - an alternative model of schooling - particularly for young adults preparing to enter the world of work, and for older adults returning to school in order to complete their training, so that they will be better prepared for retraining in a rapidly changing labor market. In the absence of operating alternatives to the traditional graded school, parents and governments have no way of assessing the merits of alternative models. In spite of the many heroic efforts of educators to grapple with the calls for "more", "better", "more relevant", etc., the structure, organization and management of the graded school makes such efforts difficult at best.

Cuban (June, 1989) develops a cogent critique of the graded school, noting that it is a relatively recent development. He argues that some historians relate the rise of the graded school to the rise of the factory system of manufacturing, seeing it as an attempt to rationalize the provision of educational services. Thus the graded school philosophy was that students possess equal mental and physical capacity at any given age; have equal amounts of help available from their families; and will be taught by institutions whose staffs are more or less of equal capability. Implicit in this philosophy is that educational quality and standardization of outcome is attained through uniform treatment. While this may be a laudible democratic ideal, it does not square with reality. Further, as Cuban points out, because of its historical success, the structure and organization of graded schools is viewed as legitimate by the community in which they operate and by most people in our society. Thus, he argues, the structure helps legitimate the ideas, behaviour and attitudes of instructors, students and parents. For example, failure "to make the grade" is routinely directed to the student, the family or the sub-culture - not the school. He argues that it is time to re-examine the institution of the graded school and determine the degree to which it is the source of many of the problems facing our educational system.

This paper, however, does not argue that all traditional schools are all bad for all students. What is proposed is one alternative to the traditional graded high school for a particular clientele. The central purpose of the proposal is to develop, implement and test mastery learning in a continuous-progress, non-graded environment at the high school level. What is proposed is not a panacea: it is an alternative which requires development and pilot testing. The proposal focuses on those aspects of the learning environment that must be developed to test this alternative.

None of the specific changes proposed is new. What is new is the orchestration of each of them in promoting mastery learning for the complete curriculum in a technical vocational high school setting. The implementation of a non-graded, continuous-progress school promoting mastery learning for each student requires a ground-up reorganization of the structure, management, and process of implementing instruction. This calls for new roles for students, teachers and administrators, and for new configurations of existing learning resources in the service of mastery learning.

THE PROPOSAL

It is proposed that one or more continuous-progress non-graded schools be established to promote mastery learning for students age 16 or older and providing the certified equivalent of Grade 10 through Grade 12

BASIC CONCEPTS

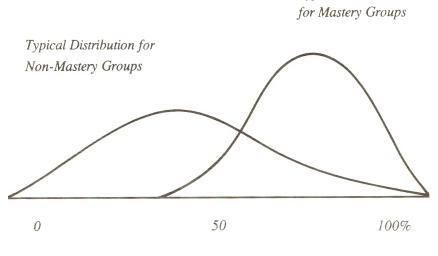
Mastery Learning

The basic concept is that most students, perhaps as many as 90%, can become similar in their level of achievement, rate of learning and motivation for further learning when provided with favorable learning conditions.

At present, at the end of a course, students vary greatly in level of achievement, rate of learning of new ideas, and motivation for further learning. Evidence from mastery-learning research shows that this variation need not occur and that, if it does occur, it is the fault of the instructional system and not of any in-built characteristics of learners. This typical skewing of achievement distributions for mastery and non-mastery groups is schematized in Fig.1.

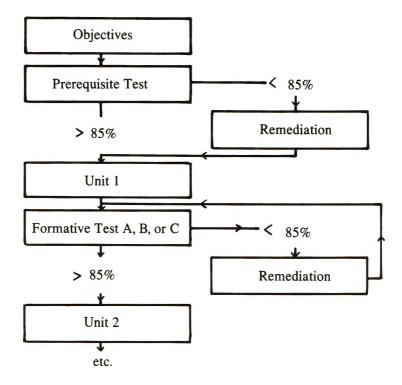
Figure 1. Comparison of Typical Final Achievement Distributions for Mastery and Non Mastery Groups

Typical Distribution



In general terms, mastery learning strategies include the following.

- (a) Mastery is defined in terms of defined objectives, skills, or competencies.
- (b) The student is provided with a pre-test to assess his prerequisite knowledge before the first unit.
- (c) If any of the prerequisites are missing, the student receives remediation
- (d) The instruction is organized into systematically arranged units.
- (e) Diagnostic progress tests are administered at the completion of each unit. An arbitrary level of mastery is determined (e.g., 85%).
- (f) On the basis of the diagnosis, each student's learning is supplemented by appropriate instructional resources.
- (g) After this the student moves on to the next unit.



The Learning System

In order to maximize the implementation of a mastery-learning paradigm, it is proposed to organize the school around three integrated learning sub-systems - guided independent study using modified correspondence-school lessons; small group seminars (learning circles); and, in-depth projects (community partnerships). All of the above require the support of micro-computer/communications facilities.

1. Guided Independent Study. The first learning subsystem requires the development and use of self-study learning material. It is suggested that

learning material already available in the form of correspondence lessons be used as a point of departure for the preparation competence-based independent study packages. The courses selected would be the choice of the school staff. The skills and competencies to be learned through guided independent study would be consistent with whatever guidelines are in place for the province in which the school is located. The independent study material is composed of small sub-units explicitly designed to promote specific skills and competencies. These, in turn, are derived from an analysis of what skills and competencies are deemed desirable by the school. Therefore, school staff would have an opportunity to reconfigure and renew the vocational curriculum jurisdiction, perhaps working in close collaboration with business and industry in the community. This opportunity is an important feature of this proposal, given the current rethinking and review of curriculum in vocational education. Also, in order to increase the probability of mastery of the skills and competencies comprising each lesson, the following two principles must be incorporated into the first learning subsystem.

a) Realignment. It is necessary to articulate learning objectives for each unit and sub-unit for each correspondence lesson; to ensure that both the embedded self tests and the end-of-unit mastery tests for credit adequately test the objectives and the domain of subject matter in the unit/lesson; and to verify that the content and instructional exercises are relevant to both the objectives and the tests. Thus objectives, instruction and testing are aligned.

It is important to note that all the test items must be designed as criterion-referenced items, and not

norm-referenced items. This means that the criteria to be achieved are expressed in terms of desired performance levels on related tests, with students being required to achieve those levels in order to receive credit for what they have learned. This is a key difference between the proposed school and traditional schools: it underscores an entirely different set of values and philosophy. Test procedures in traditional schools are deliberately designed to differentiate between students. For example, test items are specifically designed to differentiate between weak students and strong ones. In contrast, criterion-referenced items test mastery of a set of predetermined competencies (desired performance levels), and the test items are specifically crafted to sample the total domain of skills and competencies making up that domain. This is a difference that permeates marking. recording student achievement (student transcripts). and communicating a new approach to the public.

b) Tutors. The second principle is to augment the realigned learning material with tutor/guides. The learning material, while designed to be self-instructional, requires the availability of tutor/guides to provide emotional support, technical help, and motivational/pacing support. This is crucial to the success of the sub-system. Indeed, the power of tutorial instruction is well documented. and in combination with the modified aligned self-study material, the promotion of mastery of the skills and competencies in the selected curricula is then highly probable. The tutor/guides need not be certified teachers. Graduate students pre-service teacher-trainees), retired instructors and members of the local community could well serve in this capacity. All would be supervised by the Learning Manager (a provincially certified teacher) responsible for the particular subject area.

- 2. Learning Circles. The second learning sub-system consists of controlled small group seminars or learning circles. As a group of students (8-10) achieve mastery of a learning domain or set of units, they are scheduled into seminars. The purpose of this learning sub-system is to: promote higher-order cognitive skills (analysis, synthesis, problem solving); provide opportunities to engage in oral debate/discussion among peers, all of whom have achieved a basic minimum standard of knowledge concerning the issues to be discussed: and enable and encourage the development of individual student interest in topics/projects they wish to pursue in depth (see below). The total number of seminars for each course would be determined by the Learning Manager (LM) for the course.
- 3. In-depth Projects (Community Partnerships). The third sub-system grows out of activities 1 and 2. Each student would engage in several in-depth projects using community resources. Each project would be a learning contract, with a mutually-agreed work-plan signed by the student, the LM and the community partners.

Unique Attributes of the Alternate School

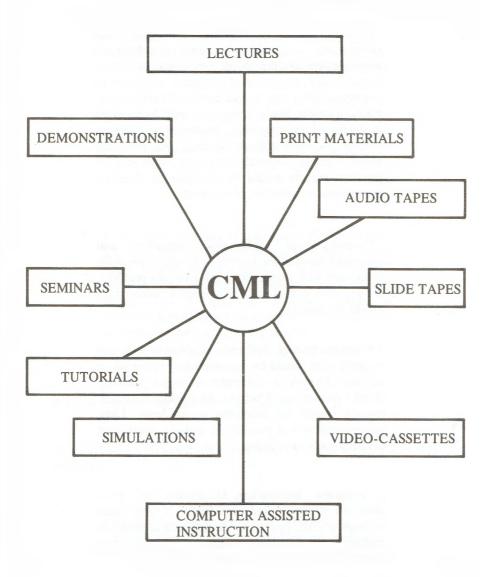
The following attributes will ensue from full implementation of this initiative.

1. A continuous-progress, non-graded learning environment. Since there are no "classes" and "grades", students could, depending on resources, enrol at any time of the year and, theoretically attend

during any time of the day or night. As is sketched out below, meticulous attention is provided to tracking, monitoring and recording each student's progress. Progress through the modularized competency-based curriculum would be translated into grade equivalencies as required.

- 2. Mastery of the competencies and skills in the curriculum, and criterion-referenced measurement and reporting. Assessment of student achievement would be determined in terms of mastery criteria established by the LM responsible for each course. Student progress would be reported in terms of competencies mastered, not scores earned on norm-referenced tests. As indicated above, grade equivalencies for comparative progress reports would be available to receiving institutions or agencies, as required.
- 3.Promotion of higher-order cognitive and communication skills. Higher-order cognitive skills associated with synthesizing information, problem solving and verbal written communication skills would be stressed.
- 4.Frequent testing. Self tests, placement tests and mastery tests would be accomplished either on-or off-line through a computer-managed learning (CML) system (see 5 below). As a result, feedback reports would be available to students, LMs, administrators and parents on a daily, weekly or monthly basis as required.
- 5. Progress monitoring. Monitoring of each student's progress and scheduling would occur through a CML system, i.e. a software application designed to manage learning activities and materials in an education environment.

Figure 2. CML In An Educational Environment



A mature CML system possess the following characteristics (Computer Based Training Systems, undated):

- Collects and stores relevant data from the learning environment
- Diagnoses student progress based on the mastery of learning objectives
 - Allows students private access to self-tests
- Prescribes remedial-learning opportunities to students when needed
 - Maintains secure instructor-prescribed tests
- Displays student and group progress on demand
 - Provides student with help on request
- Permits independent test banking when necessary
 - · Analyzes test items when specified
- Provides electronic mail communication within CML
 - Provides access to computer phone facilities
 - Utilizes computer editing systems
- 6.One-on-one tutor support. A variety of para-professionals, graduate students, tutor/aids will provide intensive personal attention for remediation/counselling or enrichment, depending upon student performance as diagnosed by the LM. Classroom-based instruction does not enable one-on-one, intensive, long-term interaction between an instructor/tutor and student.
- 7. Rate of progress. Progress through the curriculum would be largely student paced. Students would proceed more nearly at a pace, and draw upon learning resources, consistent with their optimum learning styles. As a result, for many, considerable free time would be available to explore areas of interest in more depth and engage in part-time work, etc.

8. Access to computers and productivity software. The use of microcomputers would be routine for each student since computers would be scattered throughout the school to support CML applications and would be available to support work throughout the curriculum.

9.Community-school partnership. Through cooperative ventures with school staff to design the learning material and plan student community projects, enhanced relationships between the school and community should emerge.

What Happens to a Student on a Typical Day

- 1. Home room, announcements, attendance, etc.
- 2. Independent learning activities. Some students would move immediately to learning stations to pursue their independent study, beginning where they finished the last day. A typical sequence might be as follows.
- a) on-line diagnostic placement test;
- b) print/media off-line self study material;
- c) on-line self-test;
- d) remediation with the tutor, if necessary, or back to the terminal for an end-of-unit mastery test.
- 3. Typically, following a unit mastery-test, a student would be scheduled on-line to a Learning Circle (small group seminar) with a Circle Leader for in-depth discussion, verbal-communication skill building, and information synthesizing. In addition to building higher-order communication skills ideas for the in-depth community partnership contracts would ensue from time-to-time.

Achievement scores on completed contracts would be added to the student's data-base for inclusion in final-achievement scores for that unit.

Basic Requirements for Start-Up

The proposed school would require at least the followong elements.

- 1. **Political.** Since the curriculum is at the high school level, one or more provincial departments of education and school boards would have to be players, and sanction the initiative.
- 2. Financial. Three sources of direct fiscal or indirect in-kind support would be located provincial, federal and private sector. All three have a stake in the outcome of the proposed initiative, therefore all three should become stakeholders.
- 3. **Technical.** A myriad of technical issues need attention. Some of the more salient are as follows.
- a) Learning material. The learning material currently available from correspondence schools needs to be recast into a competency-based, modularized format, and realigned as described above. This would take about one year, and would require up-front development support. The process could begin with existing Grades 10 and 11 courses in the first year, and Grade 12 in the second year. Following approximately one year of curriculum development, the first group of students could be enrolled at the Grade 10 level, with many proceeding through Grade 11 material in their first year. In the next year, a new group would enter at the Grade 10 level, with the initial group proceeding to Grade 11 and 12 level material, and so on, Revision of the learning material and delivery systems would occur as a result of the first year of debugging, (year 2 of the project), and be ready for re-implementing in Year 3.
- b) CML Developing and implementing a mature, tested, computer-managed support system (CML) to enable each student to be tracked through the learning system components would be critical to the success of the initiative.

- c) Staffing. A variety of staff would be required, including Learning Managers (LMs); instructional-system designers; para-professional tutors/aids; instructional technologists; and instructional psychologists to work in teams with the LMs, computer professionals and administrators all subscribing to the philosophy and values implicit in the alternative school proposed.
- d) Computer support. In addition to the essential CML system, a variety of microcomputers and associated productivity software (spread sheets, work processing, information retrieval from data bases, etc.) would need to be acquired to support learning in all subject areas. Applications to the language arts (word processing):, to information retrieval and information processing (all subjects, and, where appropriate, to on-line instruction, particularly in mathematics, are all feasible.

CONCLUSION/SUMMARY

It is proposed to establish a non-graded continuous-progress alternate school designed to promote mastery of the skills and competencies of the technical/vocational high school curriculum. By applying the principles and practices of mastery learning, it is proposed that most students enrolled in the school will achieve mastery (80 - 90%) of the technical/vocational curriculum.

A number of important advantages are expected to result from implementation of the proposed alternative.

1. Success experiences will be realized by students who may have been turned off by the traditional school. The proposed alternative school is designed to promote skills/competencies and success experiences in a non-threatening, non classroom-based, flexible environment. The model stresses diagnostic assessment and appropriate

placement of each student in a modularized curriculum. Students will be treated like adults and have adult responsibilities, and will have adult guides/tutors available at all times to assist them when called upon (or when necessary as determined by the CML tracking system). Further, it is expected that considerable age-mixing will occur. For example, the compositon of the Learning Circles will vary from course to course, and within a course over time. The compositon is not determined by the age of the attendees, or their grade, but rather by their progress through the learning packages.

- 2. Students will experience in-depth, structured opportunities to develop higher-order cognitive skills, (e.g. problem solving) and skill in both oral and written communication.
- 3. The continuous-progress, flexible-intake and output schedules for each student, when combined with the requirements for in-depth projects requiring community resources and contacts, provides ample opportunities for the systematic exploration of a variety of community partnerships with business and industry and other community agencies.

The proposal will be achieved by reorganzing the structure, management and implementation of instruction in the school around three principle learning sub-systems: a) guided independent study; b)guided small group discussion/seminars; and c) individual in-depth projects (community partnership).

Such a school could provide a new model of schooling, particularly for adults who are preparing to enter the workforce, or are re-tooling themselves to be better equipped to function in a new labour market for which they perceive they are ill equipped. Beyond the obvious advantages to individual adults, the overall output from such schools should significantly increase the quality and quantity of technical and trades people for the labour market and arm them with the renewed confidence to become life-long learners.

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