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ABSTRACT

This study involved examining the nature and scope of numeracy, distilling out the important features, and representing these features in sample numeracy materials. The paper examines the precise nature of numeracy and its scope in enhancing the educational experiences of adult learners. It is intended to discuss the characteristics of the adult learner--those that help learning and those that may potentially hinder the learning process. A set of guidelines are outlined which include suggestions for guiding the development of literature and the findings of an evaluation process which was undertaken among practicing adult numeracy tutors. (Contains 58 references.) (ASK)

Guidelines for the Development of Adult Numeracy Materials

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Introduction

The background to this study is research conducted for a masters thesis at the University of Limerick. The initial momentum came from the frustrations being experienced by colleagues and the author in our efforts to teach numeracy to adult learners in a prison context. The dearth of appropriate materials to facilitate the teaching and learning process hindered the quality of the experience for both parties. The study involved examining the nature and scope of numeracy, distilling out the important features and representing these features in sample numeracy materials.

This presentation will consist of three stages; the first task of the study and a logical starting point for this paper was to examine the precise nature of numeracy and its scope in enhancing the educational experiences of any adult learner. Secondly, it is intended to discuss the characteristics of the adult learner - those which help learning and those which may potentially hinder the learning process.
Finally, a set of guidelines will be outlined which are suggestions for guiding the development of adult numeracy education materials. These guidelines are derived from a distillation of literature and the findings of an evaluation process which was undertaken among practising adult numeracy tutors.

Perspectives on Numeracy

The term numeracy was first coined in 1959 by the Crowther Committee. It was strongly related to literacy at its inception. Since then it has undergone many changes in definition. A brief overview of some of the perspectives which are currently evident in the literature will be presented. Firstly, one cannot but be struck by the political rather than scientific nature of the definitions and perspectives. Chapman and Lee (1990) point out that it does not make sense to view either literacy or numeracy in isolation from a literate society. O' Donoghue (1995) highlights the time-dependency

nature of numeracy. Thus, it is a term which is related to both the learner's chronological age -for it makes no sense to define a three year old as an innumerate - and also to the period or era in which it is being considered. As Steen (1990) points out significant changes in the curriculum have occurred since the days of the merchants of Venice when compared with those of the computer society. Lesh and Lammon (1992) give a very concrete example of this relationship between time and knowledge by pointing to the introduction of Cartesian co-ordinates - relatively elementary to most mathematics students, yet prior to Rene Descartes, not within the conceptual system then available.

Examining the literature related to numeracy, three distinct broad categories of definitions can be identified. There are those which relate to *social requirements* (Evans 1992; Thorstad 1992 and Paulos 1988). Secondly, a set of definitions point to the strong link between numeracy and *mathematics* (Sowder 1990; Edwards 1988 and Le Roux 1979). Finally a group of authors strongly tie any definition of numeracy to *literacy*, (Gal 1994; Skovsmose 1994; Galbraith 1992 and Chapman and Lee 1990). A common theme which threads all of the definitions is that of ***communications***. All authors identify a role for numeracy in enhancing the transmission of information in order to facilitate an individual's understanding of the world.

Perspective 1: The mathematics of numeracy

The Collins dictionary defines numeracy as the ability to perform basic arithmetic problems. Such a definition is clearly very limited in scope, the key is to deliver the right answer by executing one of the four operations. This definition does not necessarily require any real comprehension of the many and varied concepts in mathematics; symmetry, rates of change, probability etc. nor does it suggest that numeracy requires one to make value judgements regarding relevant or irrelevant information. The Clearinghouse in Australia for Adult Basic Education and Literacy (CAABEL) defines numeracy as the "understanding and application of the mathematics that a person requires for work, study and everyday life" (1993). This definition goes considerably further than that of the Collins dictionary, in that no limit of "basic" is placed on the level of mathematics involved in numeracy. It is more similar to the definition put forward by Cockroft (1982) in that it sees numeracy playing a role in the many contexts wherein mathematics are required. This in very much along the lines of the Shell Centre for Mathematics Education who define numeracy as "the ability to deploy mathematical and other skills in tackling problems of concern or situations of interest in everyday life" (1987). Again mathematics is to the fore as being an essential component of numeracy. However "other skills", while not

specifically identified in the definition are also required. There is widespread agreement that numeracy is indeed concerned with numbers (Gabony and Traxler 1982; Derrick 1984; Edwards 1988; Sowder 1990). Furthermore, the majority of the references to numeracy create strong links with mathematics and mathematics education. However, differences come to the surface when efforts are made to specify the relationship between mathematics and numeracy. This notion of "critical awareness" and the possession of "number sense" is advocated by many authors (Le Roux 1979; Penny 1982; Edwards 1988; Sowder 1990; Trefflers 1991). Number sense as defined by Edwards involves "having a general level of quantitative literacy and mathematical understanding". In simpler terms it requires one to be capable of doing mental arithmetic and having the ability to compare numbers. He elaborates further to explain that in order to be categorised as "numerate" one must be capable of dealing with the following areas of computation "in the head" as it were, or without the use of pen and paper; addition, subtraction, finding the mean, multiplication, division and percentages. Sowder (1990) further sets down the criteria of being flexible in dealing with computation and being able to apply both the associative and the distributive properties of numbers correctly. Edwards maintains that the need for a well developed number sense has grown rather than receded in importance since the advent of the hand-held calculator, in order to facilitate judgement of the feasibility of an answer.

The core curriculum subject most closely linked to the development of numeracy is mathematics. However the tensions between school mathematics and numeracy education has been highlighted by a number of authors. Forman and Steen (1995) point to the incongruence which often exists between classroom mathematics and workplace mathematics. They point out that everyday mathematics are generally concrete but not necessarily straightforward. The notion of one 'correct' method does not really exist in the workplace. Reyes (1990) highlights the fact that in contexts beyond the classroom ***estimation*** is a vital and significant skill and yet is given little credence in the classroom. Stigler and Baranes (1988) refer to research which would suggest that numeracy is often developed irrespective of the interventions of the educational system as people devise their own methods of calculation in commercial contexts which are quite dissimilar to those taught in formal mathematics education. Finally, the authors point to the practice of working in isolation in the mathematics classroom, when many job advertisements require that workers be able to operate as part of a team and the current buzz word in Europe is 'Partnership'. Yet there is little evidence of this psyche penetrating classroom practices - the maintenance of discipline being more valued than the nurturing of collective work skills.

The Royal Society of Arts (1980) differentiate between numeracy and arithmetic and

assert that numeracy is specific to the individual while arithmetic is 'contrived' in that 'problems contain data necessary to solutions so students need never to develop skills of selection of what is relevant'. Thus the notion that numeracy must involve some element of 'critical awareness' or 'intuition' is identified, a notion advocated by many authors (Le Roux 1979; Penny 1982; Edwards 1988; Sowder 1990; Greeno 1991; Trefflers 1991).

The inclination to link numeracy firmly to mathematics raises a number of vexing issues. Certainly the job of defining the concept is made easier, as is the job of 'measuring' one's mastery or otherwise of the knowledge involved. Thus boundaries are being established which facilitate the measurement of the concept, but fail to allow it full scope.

Perspective 2: Numeracy and everyday life

A number of authors link numeracy to activities engaged in during the businesses of everyday life (Gabony and Traxler 1982; Logue 1985; Galbraith 1992; Evans 1992). In much the same way as motor skills may be defined as 'open' or 'closed' depending upon the context in which they are executed, numeracy may be said to be the 'open' dimension of mathematical knowledge, in that a number of external factors impinge on the decision regarding what strategy to use when dealing with a situation requiring the application of mathematics. Thus the context is of major significance in the application of numeracy. Collins (1992) speaking about workplace mathematics points out the social setting in which it occurs and highlights that intuitive reasoning is generally acceptable and the degree of precision is determined by the situation.

Evans (1987) identifies a number of disparities between classroom mathematics and everyday 'numeracy'. Firstly he identifies the *goals or values of the activity* within which it makes sense to pose the problem. Within the mathematics class precision is valued and indeed expected in all instances - a point also identified by Reyes (1990), whereas in most daily application of numbers approximations suffice. Next he comments on the social relations in the setting within which the problem is posed. In the school setting the relationship between teacher and learner is a formal - and at times painful one- as opposed to situations encountered in the workplace, in the home or at recreation, where relationships are considerably more informal. Thus, here is a difference not only in terms of the cognitive demands but also the affective environment within which the manipulation of concepts and numbers takes place. Finally, Evans examines the material resources which assist the activity. Calculators are commonplace in daily situations requiring the application of mathematical knowledge

but are still taboo in the majority of classroom settings where a suspicion about them eroding the quality of learning still abounds.

A reasonable interpretation of the link between numeracy and everyday life is a situation which prevails when mathematical knowledge matches the personal requirements of the individual *within his/her roles.* Thus *context* is a significant factor which relates back to the idea of an 'open' skill.

Perspective 3: Numeracy and citizenship

Many authors write about the link between numeracy and citizenship-both in terms of its contribution to the individual whereby it facilitates quality employment and guards against exploitation of the person and also its role in aiding the individual to make a more meaningful contribution to his/her community (Gal 1994; Evans 1992; Paulos 1988). Levinger (1996) speaks of citizenship in terms of inclusion and participation. Thus a numerate person is better equipped to understand and contribute to debate on health, education, justice, the economy etc. on one hand and better able to avail of the benefits of their society on the other hand. Indeed Thorstad (1992) recommends that the above themes be examined within the context of numeracy education. Almost a decade earlier Traxler (1982) had practised numeracy education along these lines viewing it as "a basis for criticism .....and as a basis for action". Evans (1992) sees statistics as forming the bases of adult mathematics education. He advocates putting in place what he calls 'Barefoot Statisticians' who could become actively involved in community research. This same author warns of the implications of innumeracy for the individual at two levels; material and ideological. On a material level innumeracy means restriction of opportunity of access to training, further education and employment - an assertion supported by the NALS survey of 1992. On an ideological level the individual loses out in terms of a lack of self confidence and in turn an inordinate dependency on 'experts'. Paulos (1988) points out that for society in general, large scale innumeracy results in a waste of resources, loss of production and at an ideological level the propagation of myths which may in turn influence values.

Perspective 4: Numeracy and communications

The origins of the term 'numeracy' and its link with literacy have already been mentioned. Crowther viewed numeracy as a tool to enhance our understanding of the world that surrounds us, a view also espoused by Gal (1994). Crowther allied numeracy to the natural sciences, a theme followed by Le Roux (1979) who spoke of numeracy at its most basic level enabling one to obtain and use information for the

purpose of description, formulating theory and testing the validity of a theory. Penny (1982) actually defines numeracy in terms of communication,

> "....the ability to understand and use mathematics as a means of communication; to interpret a situation given in mathematical terms or to employ mathematics to represent a situation and if necessary to use mathematical symbols to obtain further information.

Much of the literature discusses the need for 'quantitative literacy' (Le Roux 1979; Galbraith 1982; NCTM 1983; Gal 1994). This in turn is defined by Kirch (1993) as 'the knowledge and skills needed to apply arithmetic operations embedded in written materials'. The American view of numeracy allies it very closely with functional literacy in that true literacy is only achieved through comprehension of quantitative concepts and a developed ability to communicate quantitative information. Gal (1994) sees numeracy has having a positive role to play in enhancing an individual's appreciation and understanding of the world in which (s)he lives.

Instructional Implications of these Perspectives

Having examined and considered the various perspectives of numeracy as offered by a variety of interested parties, this authors are convinced that there is merit in each view. It is evident that they are not mutually exclusive perspectives and that nuances of one complements the others. Indeed, there is merit in attempting to incorporate aspects of each perspective into any numeracy course - the degree of emphasis will be determined by the purpose of the specific course.

When dealing with adults, the authors believe it to be essential to blend compatible and important aspects of different approaches into a coherent framework. An over-emphasis on mathematics may result in a perceived lack of relevance among the learners. Similarly an over-emphasis on everyday mathematics may limit the programme to mathematics which are deemed to be 'easy' by the learner and thus the challenge and resulting motivation may be eroded over time. Focusing exclusively on communications or citizenship may result in the development of a programme of learning which fails to meet the learners' expectations of what is 'real mathematics'.

The review which has been presented is comprehensive but as with all reviews it is not by any means all-encompassing. Recent years have witnessed the emergence of new areas and issues in mathematics education research e.g. mathematical cognition in everyday life (Lave 1988), street mathematics (Nunes, Schliemann and Carraher 1993)

and gender and mathematics (Burton 1990). These areas of study in mathematics education are certain to influence the development of numeracy education in the future.

Characteristics of the Adult Learner

Due to the dynamic nature of our society in general and the workplace in particular there is a growing number of adult learners in an array of contexts in the broader community than ever before. Distance education, evening classes VTOS programmes and literacy schemes are some of the key channels through which adults are facilitated to pursue further learning. Many job advertisements highlight the professional training and education opportunities which the employer is prepared to offer in order to entice the 'right' candidate. 'Lifelong Learning' is a relatively new concept introduced into education, with the year 1996 being dedicated to the enhancement of the notion.

A number of authors have written about the characteristics of adult learners (Knowles, 1984; Trezise, 1993; Tough, 1978; Thomas, 1984; Kerka, 1994). Across the spectrum of authors there is some discord in relation to the precise characteristics of the adult learner. Knowles (1984) would contend that adult learners are self directing, while Kerka (1994) would assert that within the mass of learners who are adult learners there is a huge degree of variation in relation to self-direction, as great as within any other group of learners. In the experience of the authors Lester's (1994) analysis of adult education most clearly represents reality. Lester contends that those involved in 'post compulsory' education lie somewhere on a continuum. Those who freely choose to participate in learning lying on one end and at the other end those who were coerced into participation. In the prison context those who presented to class rather than clean a landing were representative of those being coerced. An individual's position on the continuum greatly influences both their motivation for learning and their criteria by which they measure success.

Many authors write about the role of education in improving an individual's self esteem (Imel, 1990; Payne, 1993; Cousins and Pound, 1981; Adler, 1988). Writing specifically about numeracy education programmes Traxler (1985) states,

> The first and most evident reason for wanting to succeed at school mathematics was that although the mathematics may not have been important the success certainly was. (pg. 74)

Thus the importance of knowing a learner's criteria for success and facilitating this is of paramount importance in all educational situations.

However not all outcomes of an adult education programme are positive. Griffin (1993) refers to Fingeret (1983) who illustrated that participation in basic education programmes may place a strain on existing relationships and support networks - as was evident in the film 'Educating Rita' where the main character's pursuit of knowledge clashed violently with her cultural origins. This is only one potential clash. A learner's expectations of what is 'mathematics' may lead to tensions in the learning/teaching situation. if the expectations of rote learning of tables and lengthy periods of practice of skills are not met. Another area requiring consideration is that of mathematics anxiety, a condition which involves an emotional barrier being put in the way of cognitive advancement. The need to listen to the learner is propagated by a range of authors (Quilter and Harper, 1988; Daines and Graham, 1992; Lester, 1994). Thus a degree of consultation and negotiation which shade the adult learning situation and in the words of Coben (1985) 'The mathematics taught is likely to be a compromise between what students say they want and what the tutor feels they need (and feels confident to teach them).

Guidelines for the Development of Adult Numeracy Education Materials

A distillation of the survey of literature led this study to the compilation of a set of guidelines to direct and inform the development of materials and methodologies for use with adult numeracy students. Some principles of programme design for adult numeracy education courses will be discussed and ways in which they might be used to guide policy and practice will be illustrated. The characteristics of adult learners as discussed earlier must form the foundation upon which all programme plans are laid. The heterogeneous nature of adult groupings must be given consideration, as must the cultural contexts in which mathematics is practised by adults. The recent findings of cognitive scientists must be regarded so that the learning experience complements the learning styles of adults.

The following principles have been identified as being central to the development of adult numeracy programmes:

- Adult numeracy education must be founded on the learner's prior experience.
- Adult numeracy courses should be 'context' rather than 'content' focused.

- Adult numeracy education courses should develop higher order skills.
- Assessment of adult numeracy programmes should accurately reflect the purpose(s) for which the knowledge is being sought.
- Adult numeracy programmes should focus upon communication aspects of mathematics.

The first of these principles is one which has already gained credence in the adult education arena and thus will be given minimum attention in this paper. Basically the initial stages of any numeracy programme ought to involve helping the participant to unlock any latent mathematics knowledge he/she possesses, and having acknowledged its existence, building on it to further his/her confidence and abilities. Cummings (1995) contends that adults are in fact mathematically very competent, they fail in the translation to formal mathematics.

The significance of context in adult learning is also widely acknowledged as a consideration in the enhancement of learning. Nickerson (1988) identifies a number of reasons why individuals fail to use knowledge they have in given situations. One of these reasons is a lack of understanding of the conditions under which the knowledge may be applied. This problem could well be minimised if mathematical knowledge was related to a variety of contexts in the first instance, and its relevance to these contexts explicitly examined and focused upon by the learner. The crux of the problem is one of a distinction between available and accessed knowledge. Having knowledge is no guarantee of using it. Nickerson refers to a number of studies which advocate the teaching of strategies in tandem with conditions under which it might be applied.

In relation the third principle there is general agreement in education circles that assessment ought to form an integral part of the teaching-learning cycle and that it should take place at various stages in the process. Imel (1990:1)quotes the Business Council for Effective Literacy (BCEL 1990) "...the paramount purpose of assessment should be to help the learner achieve his or her goals; what is assessed must reflect what the learner wishes or needs to accomplish."

The fourth principle is one which is relatively new in the area of numeracy education as it would initially appear to be at odds with the term 'basic education'. However in general the need and desirability for the development of higher order skills abounds in educational literature. Romberg (1990) and Levinger (1996) see the development of these competencies as essential components for engagement or participation in the 'new world'. The transition from the industrial era to the information / technological

'third wave' (Toffler 1980), is making redundant the need for production line workers who operate in isolation from others and who work willingly on repetitive tasks, taking orders unquestioningly. Instead, the need for initiative, team work and flexibility is becoming more evident. Romberg identifies the tendency to break all processes into its component parts as a feature of the industrial age. This was thought to crystallise the process and thus simplify tasks - a view dismissed by Forman (1995) who states "it is harder, not easier to understand something broken down into all the precise little rules than to understand it as a whole".

The appearance of terms such as 'critical thinking', 'communication' and 'authentic assessment' are a major feature of educational literature of the past decade. They are also featuring in articles and books dealing specifically with mathematics education. All of the above are seen as essential educational outcomes and practices if tomorrow's workers are to show improved deftness in managing ambiguous and complex situations. Levinger goes further to say that higher order skills will be *"sine qua non"* for long term employment prospects. She also asserts that the development of higher order skills presents an unprecedented challenge to today's educators. Resnick (1987) - cited in Nickerson (1988)- identifies the characteristics of higher order thinking as follows; the ability to interpret unfamiliar texts, create materials others would want and need to read, construct convincing arguments and develop original solutions to technical or social problems. Newmann (undated) -also in Nickerson- describes higher order thinking as requiring the resolution of conflicting views, tolerance for uncertainty and ambiguity, self-criticism, independence of judgement and serious consideration of ideas that may challenge conventional wisdom. Higher order thinking has a number of features which, according to Romberg (1990) conflict with traditional mathematics education. For instance, higher order thinking generally involves multiple solutions as opposed to one unique answer as tends to be the case in standard mathematics education. Thus, uncertainty is a feature of higher order thinking. That is to say that not everything that bears on the task is immediately known, as opposed to traditional mathematics education where all, and only essential information is given, thus leaving no room for ambiguity, interpretation and further investigation. Traditional mathematics is regulated by external rules, thus leaving no room for self-regulation. On the other hand, higher order thinking demands that an individual 'makes contact with his/her own thought processes in order to solve a problem'. Levinger(1996:9) cited the findings of a number of cognitive scientists who maintain that it is indeed possible to "facilitate a learner's development by helping that individual build better rules to solve problems". The implication here is that individuals actually have inherent problem

solving rules. Education is the means by which these abilities are fine tuned and improved in term of efficiency and productivity.

The relationship between numeracy and communications relates back to the origins of the term. A significant number of authors campaigning for communications as a product of numeracy education have been cited (Le Roux 1979; Galbraith 1982; Gal 1994). They see the application of mathematical knowledge in a variety of contexts, from reading bus schedules to analysing and interpreting graphs describing the performance of shares on the stock market. Numeracy is also very much seen as a facilitator of knowledge between various disciplines, science, social studies etc. The need to create a link between mathematics education and a variety of contexts is strongly endorsed by Evans (1992) who is critical of traditional mathematical education which is often divorced from the out-of-school experiences of the learners.

The technological advances of the recent past have radically extended the situations in which mathematics is useful, and this expansion has occurred concurrently with the increasing kinds of mathematics that are useful and finally the range of people who use mathematics on a daily basis (Lesh and Lammon 1992). Romberg (1990) insists that the change from an industrial society to an information society is "an economic reality, not merely an intellectual abstraction". He stresses the necessity of communication skills in a 'literacy-intensive' society. Given that numeracy is the 'mirror image of literacy', it too must complement the emphasis on communication.

Implications for the Teaching of Numeracy to Adult Learners

The selection of material may well be central to the quality of the learning experience. Materials need to be relevant not only to the area of mathematics being covered, but also to the experiences of the learner. The management of materials is vital so that the learners are afforded the opportunity of generating or constructing mathematical knowledge for themselves. Learners may even be involved in the development of materials themselves for use with their peers. This will challenge them to put knowledge into context and consider it from the perspective of another - a method for developing higher order skills. Finally, the scope of technology needs to be acknowledged and the learner facilitated in recognising the value of technology as a means for managing and generating valuable mathematical knowledge.

Teachers theories of teaching and conceptions of mathematics strongly determine the way in which they manage learning situations for their students. In order to move numeracy education beyond 'basic mathematics', teachers need to be challenged to redefine 'basic'. Adult educators have a magnificent resource in the prior learning and experience of their students - they need to be challenged to recognise this and develop strategies for harnessing this resource. Crosswhite (1989) sees the role of mathematics teachers as nurturing, strengthening and motivating students as well as 'selling' mathematics to them. This is particularly pertinent in adult education where the tutor must be accountable to the learner and justify material being covered in terms of its *value to the learner*. Finally, Evans et al (1993:7) regard teaching as an "open skill in which feedback about the environment has to be continually monitored and acted upon". Another challenge is thus posed for adult educators, namely that of developing a level of responsiveness, not simply in terms of content, but also in terms of the metacognitive development of learners so that over time they gradually learn to withdraw their support and promote the development of 'expert learners'.

Application of the Principles to the Design of Adult Numeracy Education Materials

The underlying aim of the package devised was to develop learning strategies that would; maximise motivation for learning, promote success and instill confidence and competence in using and applying mathematics, according to the demands of everyday living. An effort was made to expose some of the myths about mathematics learning - particularly those most likely to present as a barrier to learning e.g. there is only one right answer or only a precise answer is acceptable. Practice is built in regularly and learners are required to use and apply mathematics to a range of situations and contexts. This practice is also valuable as a means of assessment and learner gratification, which in turn will motivate further learning. The system takes account of prior learning and promotes the sharing of ideas, knowledge and opinions among learners which in turn facilitates peer-tutoring. The format of each lesson or stage is similar and presented as follows;

1. Review previous days work.
2. Introduction to key ideas of the lesson/stage.
3. Learners examine idea from personal perspective.
4. Learners practice using the idea/knowledge/concept.
5. Tutor receives feedback from the learners.

Features of the package

The package is presented in a colour-coded format. This is to assist the tutor in accessing relevant sections, e.g. course notes, worksheets, assessments etc. It comprises six sections; introduction, course notes, handouts, worksheets, assessments and overheads.

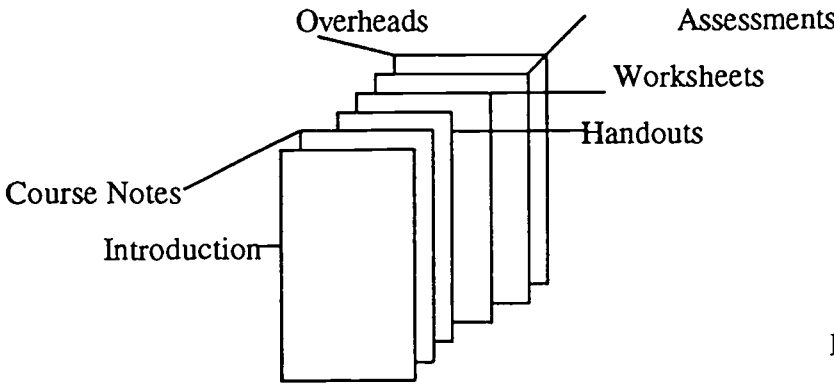

Figure 1.

Those sections which may require to be photocopied are in pastel colours to maximise copy quality.

The package actively encourages the involvement of learners' prior experience and learning. At all stages the learners are required to consider the materials in light of the demands made upon them in their general day to day practices. Allocating time to establish in the minds of the learners the *relevance* of the material is deemed essential in maximising *motivation* for further learning. A combination of tutor exposition, worksheets, questioning, and group discussion is used to place all materials in an adult context. All materials are embedded in everyday situations -work, business and recreation- in order to *connect* mathematics to real life experiences. Newspaper articles are a particularly valuable resource in the adult numeracy classroom to facilitate the making of connections.

The development of higher order thinking skills is promoted through the use of interactive worksheets. Learners are required to make value judgements and provide rationale for their interpretation and/or answer. The tasks outlined for scored discussions require that the learner filter out irrelevant information and select what is pertinent to the situation in order to formulate an answer. Throughout the package affective aspects are being challenged and nurtured in order to maximise the learner's attitude and motivation for learning.

Assessment methods focus beyond the obtaining, or otherwise, of the 'right' answer. Credit is given for reasoning and active involvement in the process of learning. The interactive teaching/learning methods allow for on-going assessment by both the tutor and the learner.

The use of worksheets, group discussion, brainstorming, buzz grouping and scored discussion highlights the communication potential of numeracy. Throughout all stages of the package communication about procedures, attitudes, knowledge and feelings is facilitated. This is deemed to be a significant feature of the package as it maximises successful achievement of the other four principles of design.

Conclusions

The ideas above are intended to be of assistance to any practitioner who finds him/herself in the frustrating situation of trying to piece together a meaningful adult numeracy education programme from a range of materials which partly but not fully meet their requirements. The suggestions above certainly require a degree of commitment in terms of time and imagination, but the authors would argue that this output will ultimately be no more than what is required to scour an array of packages and piece together 'a solution' to the frustrations.

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