

Theoretical framework for applied climate education:

1. Adult learning concepts and principles to consider when developing and delivering training

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1. Introduction

The variable climate has major impacts on agricultural production and sustainable resource management (Nicholls 1985; Garnett and Khandaker 1992; Buckley 2000). Better understanding of this variable climate in terms of how it impacts on production, natural resources and markets is critical for producers and agribusiness to maintain or improve their industry (Hammer et al. 2000). Improving knowledge and skills to better cope with climate is a goal that the Australian government has been working on since drought was no longer to be considered as an 'exceptional circumstance' but with an emphasis needing to be on increased self reliance (Anon. 1990).

Effort must therefore be applied to training and education of not only producers but others in the food and fibre chain who are impacted on when:

- production has short falls due to drought or other weather and climate induced problems, or,
- communities are negatively affected by other climate related problems such as competing water issues and other resource problems like erosion or salinity.

This paper describes adult learning principles and concepts that have been used successfully in applied climate and agriculture education.

2. Background

A thorough description of the problems that occur between agriculture and the variable climate have been detailed elsewhere. The variability of the climate is described in Nicholls (1985) and Hammer and Nicholls (1996). Partridge (2001) has explicit examples of how climate variability impacts on crop, pasture and livestock production. The variable climate is not limited to affecting agricultural production but also natural resources. George (in press) considers how the variable climate impacts on soil-plant-animal-water systems. The variability of the climate affects every producer in Australia to some degree every year. Overall, unless those in the food and fibre chain are strategically and tactically prepared for the variable climate, there will continue to be problems with production, natural resources (of soil, plants, animals and water), and finances. An emphasis on planning does not remove the climate variability problem but provides a useful process for better dealing with these problems.

Another major contributing factor that adds to the problems of the variable climate and its impact on agriculture is a fragmented education approach. The national agriculture training package, which covers vocational education, did not (up to February 2000) adequately cover climate (Reischmuller pers. comm.). The secondary school agriculture syllabus for each state is independently developed. Applied climate and agriculture for the tertiary education system is also independently developed. Short courses and workshops that cover climate and agriculture which particularly target producers have been developed in each state with varying degrees of success (George et al 1998, 1999; George 1999; Grimson 1999; Anon 1999; Paull and Peacock 1999; Keogh et al 2000). Notwithstanding

the Property Management Planning approach (Anon. 1997) which was intended to address the problems of the variable climate and rural training, it is suggested this fragmented approach is not conducive to improving knowledge and skills to better cope with the variable climate as would a more comprehensive educational approach.

3. Rationale

Of course if we begin to analyse the problems of the variable climate and agriculture, the first and most obvious cause has to be the variable climate itself. If we did not have a variable climate, there would be no problem. A necessary first step is to understand how variable the climate is in a location, and know how it impacts on natural resources, production and finances – an educational process. Once this knowledge is obtained, it may then be applied to a particular situation. This identifies a learning process that may be expanded from the principles outlined by Kolb (1984) of:

- **Identifying and explore** the problem (How variable is the climate this season? What is the current situation? What is the forecast?)
- **Analyse** what it means (How will this variable climate impact on natural resources, production and finances? What are the choices – chances and consequences of any decisions?)
- **Decide** what will be done (consider the options and discuss these options with others, then make a decision based on the best information available)
- **Act** by deciding and implementing the best considered action to solve the problem

It is suggested if there is not a clear learning process in analysing the causes of a problem, dealing with a problem, considering optional solutions to the problem, then evaluating how effectively the problem has been dealt with, that is itself a major problem.

There is value in knowing ‘what you know’, but there is also value in knowing ‘what you do not know’. In an age of information overload there is a need to recognise ‘what you do not know that you need to know’, rather than believing ‘all’ or ‘more information’ is automatically ‘good information’. Certainly producers have recognised the need to know a lot more about the climate and its impacts on natural resources, production and finances (Maunder 1970, 1986). Therefore, accurate and specific climate and agriculture information, has to be a higher priority.

A fragmented education that does not cover ‘agriculture and climate’ and ‘thinking’ skills in a complementary way throughout the education spectrum, is also contributing to the problems of dealing with a variable climate in agriculture.

4. Ideas to improve the situation

There are five areas to consider when addressing the problems of the variable climate and climate education. These include adult learning concepts and principles but placed in perspective with other equally important issues.

- An education and training framework complementing secondary, tertiary and vocational education systems
- Supporting education and training in short courses and workshops that brings expertise to specific areas and regions of interest to potential participants

- Recognising and applying adult learning principles and concepts to enhance learning that ‘includes’ participants that otherwise may be ‘threatened’ by learning environments late in life
- Using forecasts. Demonstrating case studies of people using forecasts can help others to consider where they may be able to apply the forecasts to their situation (George and Brouwer 1999).
- Providing support materials that assist in adult learning (books, videos, software...)

4.1 *Addressing ‘complementary’ education*

To ‘complement’ *applied climate and agriculture* in secondary, vocational and tertiary education, it is necessary to put in place resources to address weaknesses in the syllabus and the educational system. There is now a web based teacher’s manual for ***Climate, weather and agriculture*** at the site <http://www.schools.ash.org.au/paa/cwabook/DEFAULT.HTM> (George 2001). This provides basic information and exercises that provide a general understanding of principles and concepts that deal with the topic. The vocational education system is currently undergoing a review. An exercise was undertaken to map weather and climate in the *Agriculture Training Package*. The lack of material about climate in the *Agriculture Training Package* was identified and appropriate authorities were advised of the need to raise the profile of climate as a topic on its own, as well as being an ‘element of competency’ and in ‘underpinning knowledge and skills’ in most of the other subjects. This is currently being rectified. The unit ***AG5215 Develop climate risk management strategies*** is now accredited and in place in the Agriculture Training Package. Another unit aimed for a level 3 target audience is also now in place as ***AG3514BC Monitor weather and climate conditions*** (level 5 targets ‘Farm managers’ while Level 3 aims at ‘Senior farmhand’ students). Resources have been developed to enhance tertiary teaching, syllabus and education, including software, articles, booklets, exercises and other resources (Clewett et. al. 1999; Carberry et. al. 1998a-h; George and Brouwer 1999; Partridge 2001; Clarkson et al In Press; Bayley and Brouwer 2000).

4.2 *Informal education and training*

There is a need to include workshops and short courses as informal education and training. These are designed to meet the needs of groups and so are informal to the extent of not having rigorous programs and being followed by exams. They are usually requested by groups and delivered by someone with good technical and facilitation skills. If done correctly, they can complement the formal education component and if learning outcomes are in place, the skills and knowledge learnt in their environment could be used for upgrading of qualifications by having ‘recognition of prior learning’ assessed and accredited by a registered training organisation. Informal education and training is useful because:

- immediate needs are met,
- it helps to encourage a lifelong learning attitude that meets people at their own level,
- it helps to construct knowledge based on the experience of participants,
- learning occurs at an individual level and a community level at the same time, because learning also becomes a social activity, and,
- it is not too onerous or overbearing to people who have not attended formal education recently. It simplifies or omits the filling out of forms, travelling considerable distances to a venue that at times may not be so convenient, and works at a pace that is set by the group. Learning is brought to the participants ‘door-step’.

4.3 *Incorporating adult learning principles in education opportunities*

A list of adult learning principles and concepts believed important, needs to be placed in some perspective. Malouf (1994) recognises seven laws of adult learning of 'what' is needed, amalgamating points from Kilpatrick (1997), de Bono (1992), Johnson and Johnson (1997), Tyson (1998):

- a. Learners must feel the need to learn. Allow adults to be involved in planning their own educational experiences.
- b. The learning environment must be mentally and socially safe. Avoid the old classroom approach. Try to relieve the initial anxiety and tension by responding to the needs of your audience (flexible programming)
- c. Learners must set their own goals. Adult education programs in agriculture must serve the specific needs of the clientele and provide reason for continued attendance, if the activity is to be on a regular basis
- d. Learners must participate actively in the learning process. Stimulate learning by participation and action
- e. Learners must build on and use the learner's experience. Build on local experience, lead the group from what is known to the new material.
- f. Learners must see that their learning has been successful. Allow time for your audience to think about what is being presented, take difficult subjects slowly and allow questions
- g. Learners must involve effective two-way communication. Build individual and group confidence by letting your audience know when they are right - give them acknowledgment of their learning achievement

4.3.1 *Recognising learning styles*

In addition to the above points, Honey and Mumford (1986) recognise four preferred learning styles which also need to be addressed in adult learning, which may be considered as to providing ideas on 'how' the adult learning could be addressed:

- a) **Activists.** This category is made up of people who prefer new experience and problems from which to learn. They can be engrossed in competitive teamwork tasks and role playing exercises. They prefer excitement and drama with a range of diverse activities. Providing activities for leading discussion and giving presentations encourages this learning style. This group dislikes learning from a passive role such as listening to lectures, or when they stand back and are not involved. Key questions for activists are: Shall I learn something new? Will there be a wide variety of different activities? Shall I encounter some tough problems and challenges? Will it be fine to make mistakes and have some fun? Will there be other like-minded people to mix with?
- b) **Reflectors.** This learning style likes to stand back and ponder experiences and observe them from a different perspective. They like to collect data and think about it thoroughly before drawing conclusions. They collect and analyse data and postpone reaching conclusions for as long as possible because their learning nature is to be cautious. They keep a low profile in meetings and enjoy observing other people in action and will listen to others before making any points. They like to learn where they are encouraged to think over activities. They dislike being involved in situations that require action without planning. Key questions for reflectors are: Shall I be given adequate time to consider, assimilate and prepare? Will there be opportunities to assemble relevant information? Will there be time to listen to a wide cross section of people with a variety of views?

c) **Theorists.** This group adapts and integrates observations into complex but logically sound theories. They think through problems in a step by step logical way. They assimilate facts into coherent theories. They tend to be perfectionists who analyse and synthesise and fit all details into a rational scheme. They enjoy time to methodically explore associations, and interrelationships between events, ideas and situations. They dislike learning where there is subjective judgements, lateral thinking and anything flippant. They dislike participating in situations emphasising emotions and feelings or where there are unstructured activities and uncertainty. Key questions for theorists are: Will there be lots of opportunities to question? Do the objectives and the program of events indicate clear structure and purpose? Shall I encounter complex and ideas that will stretch me? Are the approaches used, sound and valid?

d) **Pragmatists.** These people prefer activities where there are links between the subject matter and a problem to address on the job. They enjoy being shown techniques where there are obvious practical advantages, or a model to emulate. They also like to see immediate opportunities to implement what has been learned. Providing real problems and practical issues appeals to this group of learners. This group dislikes learning that is not related to an immediate need or where organisers of the learning are removed from reality and where there is all theory and general principles with no clear guidelines on how to do it. Key questions for pragmatists are: Will there be ample opportunity to practice and experiment? Will there be lots of practical tips and techniques? Are we addressing real problems and will it result in action plans to tackle some of my current problems? Shall we be exposed to experts who know what to do themselves?

A large proportion of farmers fit into this *pragmatists* category (Davey 1987, Zemke and Zemke 1981). It is essential adult learning programs targeting farmers develop teaching and learning to suit their needs.

4.3.2 *Attention to logistics and process*

The following successful strategies reflect adult learning principles and were adapted from George (1996) from work by Timms.

a) *Content*

The choice of subject matter has to be firmly established, preferably consulting the likely target audience in advance

- have summary points after each group session
- avoid likely repetition in farmer strategies which are presented
- extension efforts need to be directed at both financial and personal management
- ensure the content is relevant
- make certain there are clear learning outcomes and assessment criteria (if accreditation is sought during or after a course, learning outcomes and assessment criteria are essential). It is also necessary for any evaluation of education and training so that KASA (knowledge, attitude, skills, aspirations) may be measured as well as 'end result' and 'practice change'. There is a need to balance 'outcome oriented' learning with 'participatory problem solving'. Murray (2000) would emphasise the latter, whereas George et al.(1998, 2000) demonstrates there could be a balance between 'outcome oriented' learning with 'participatory' learning.

b) Publicity

- publicise widely in the major media used by the target group
- use radio and publicity fliers
- publicise well before the event to give people time to plan

c) Process

- encourage voluntary participation
- target the audience to enable the project to meet its specific needs
- have a set of teaching objectives to keep the workshop focussed on learning
- have messages packed around the learning objectives
- have a planned approach to information adoption
- use experimental learning rather than passive (classroom or lecture based) learning
- use a holistic method with a whole farm management approach
- use 'hands - on' sessions
- have participants work in small groups
- respect the learner and use the knowledge the learner already has
- build on the learner's experience
- foster the development of independent learners
- allow interaction and collaboration within and between participant groups and between presenters and participants
- serve the specific needs of the clients and provide reasons for continued activity
- have flexible programming to meet client needs and reduce anxiety
- simplify (segment) the task
- make the task more relevant
- strategies should be specific and practical
- displays or posters attract appeal in the topic and help create ongoing interest.

d) Venue

- venues should be chosen after considering the likely weather conditions
- location of venue greatly affects attendance
- consider the cost
- make sure the venue is suited to the workshop process and suits the equipment you may use such as overheads, slide projectors, etc

e) Presenters

- provide a helpful and optimistic atmosphere
- choose the most appropriate person(s) available to present the workshop material
- the public speaking ability of presenters must be ascertained
- provide an adequate ratio of facilitators to property owners to ensure participants receive adequate assistance
- keep things manageable for facilitators

f) Format

- present information in an easily understood way
- use a visually active demonstration technique eg. balance text and activities with slides, overheads, posters, videos, computer software on overhead panels, videos, and perhaps an outside activity that reinforces the learning
- seek professional support when preparing displays
- avoid excessive use of overhead transparencies
- use moving or interactive displays

g) Evaluation

- evaluate outcomes of the workshop using information from participants and presenter observations (Bennett 1976, and Murray 2000).
- allow time for collaborative reflection on learning experiences eg. in sessions, schedule time for reflection as well, rather than using all the time allotted for the presenters to speak only

h) Property Management Planning (PMP)

The Property Management Planning (PMP) process uses the broad framework of:

- identify needs
- develop appropriate educational / technical material in response to the needs
- deliver material according to needs in terms of workshops, information sessions, and relevant materials clients can access eg. Internet, poll fax, etc.

The PMP process provides the general framework in which we have worked to build knowledge and skills in relation to use of seasonal climate forecasts in farm management. Seasonal climate forecasting is one part of this comprehensive planning process.

i) Participative problem solving

A participative problem solving approach (as expanded in Spencer 1989) facilitates cooperative learning and may allow for the different learning styles of participants (Honey and Mumford, 1986). The information is not intended to help just in short term decision making (even though it does this), but rather to be an integral part of each stakeholders strategic planning process. The participative process builds on the PMP process to use information to assist producers to participate in problem solving activities to work out:

- **where am I now?** (this is an inventory of personal, financial and physical resources of which weather and climate information is an integral part)
- **where do I want to go?** (goal setting)
- **how will I get there?** (setting strategies and actions, and comparing alternatives, which includes assessing impacts of climate variability on enterprise outcomes)
- **how is it going?** (monitoring and evaluating progress, readjusting goals and strategies by what works and what hasn't worked etc.).
- **... and returning to 'where am I now...? ...** continuing the process with improved knowledge and skills.

4.4 Understanding and using forecasts

Understanding is a vital part of adult learning. Thus, in developing knowledge about seasonal climate forecasts that are based on the El Niño Southern Oscillation (ENSO)

phenomenon, some understanding of the processes and mechanisms of the Walker circulation is important. A knowledge of the statistical relationship between indices such as the Southern Oscillation Index (SOI) and rainfall and how to use that information is also essential, but an understanding of how ENSO interacts with the world's ocean/atmosphere circulation is important in acceptance of such relationships. Understanding data and forecasts is essential before going the next step and applying that information. Interpreting tables and graphs should not be glossed over.

Farmers and scientists learn differently and respond to information in different ways. Cumulative probability distributions provide an effective mechanism for scientists to communicate with each other. However, in communicating with the farming community we have found that other diagrams and ways of expressing risk are more effective. The simplest statement for communicating risk has been the percent chance that seasonal rainfall will be above or below the median rainfall (or above or below the average) (Stone *et al.*, 1996). The next simple level for communicating risk is to consider the chance (probability) that seasonal rainfall will be: above average (highest 30%), about average, or below average (lowest 30%). A probabilistic forecast rather than an absolute forecast is better to describe climate variability. Childs *et al.* (1991) goes into greater detail of this aspect. Demonstrating case studies of people using forecasts can help others to consider where they may be able to apply the forecasts to their situation (George and Brouwer 1999).

4.5 Adult learning support materials

There is a wide diversity in how people learn. Providing a diverse range of adult learning support materials to enhance learning on a wide population is desirable. Paull and Peacock (1999) and Balston (2000) describe in great detail the materials and information developed to improve knowledge and skills to better cope with the variable climate. It includes:

- Internet phone and fax services which have regular updates of seasonal climate and weather indicators
- Books such as *Will it Rain?, Weather and Climate in Farming*
- Mass media such as television and radio updates of forecasts
- Research and extension programs
- Decision support software such as *Rainman, APSIM, DroughtPlan* and others which have relevant climatic data for specific locations
- Workshops and short courses that suit the needs of clients eg cropping, grazing, climate and agriculture
- Educational resources like *Tutorials* that complement courses at schools, vocational colleges and tertiary institutions

5. Summary

- Agriculture and climate education is not just for farmers but rather the whole community. Farmers, agencies, agribusiness and communities need to work together to overcome problems associated with climate variability and make the best sense possible of seasonal climate outlooks. A learning approach through the Property Management Planning (PMP) process is a good way to start this (Ridge and Wylie, 1996; Daniels and Chamala, 1989; Grimson, 1999; Clewett *et al.*, 1995)

- There needs to be a greater effort on increasing the understanding of the uncertainty in seasonal climate forecasts in the community (Childs et al., 1991; Clewett et al., 1995). This will involve emphasising whole farm property management planning and working through the ramifications of a seasonal forecast and the benefits of how planning helps to make the best decisions before and, as the season unfolds.
- Misjudging climate variability and balancing property management and enterprise is complex (Buckley 2000). Information and resources need to allow for this to enable thinking and lifelong learning skills for the immediate and long term benefit (Clewett et al. 1995).
- Emphasis needs to be placed on providing opportunities that facilitate the process of learning about the variable climate and seasonal climate forecasts amongst primary producers. This needs to then be followed by how to package information (or even just provide information) to fit the process (Ridge and Wylie 1996).

There has also been insight into how people have learned. Personal observations and those of others suggest that people have learnt best where -

- an immediate problem must be solved, a task done, or a decision made that needs a new skill (Davey 1987; Zemke and Zemke 1981; Pollard 1992).
- all stakeholders are open to learning (Zemke and Zemke 1981; Thorp 1999).
- the learning process recognises and builds on the understandings producers already have (Ridge and Wylie 1996; Killen 1996; Huffman 1974).
- there is an emphasis on motivating others to come to a deeper understanding (as opposed to learning for action) of climate for the purpose of improving management (Ridge and Wylie 1996).
- information delivery/learning process is flexible to allow for differences among individuals, their backgrounds, interests and aspirations as well as family and business circumstances (Zemke and Zemke 1981; George et al. 1998, 2000).
- adults use a variety of methods in any learning project (thinking, reading, listening, asking, etc). Any learning processes need to be aware of this and deliver according to the participants needs (Davey 1987; Killen 1996).
- resources most used in self-directed learning are other people (mostly people they know well) and even 'expert opinion'. It is critically important that these not be underestimated (Underwood and Salmon 1980). Farmers that have 'survived' the variable climate bring to any learning experience a wealth of knowledge, not only of their climate but how their environment and enterprises responded to that particular situation. This needs to be acknowledged.
- learning situations provide opportunities for reflection and to identify what they do know, and, what they 'don't know they didn't know' (Thorp 1999).

6. Conclusion

The variable climate has impacts on production, resources, profits to individuals, regions and communities. Education and training that embraces and uses adult learning principles and concepts can help people to better cope with the variable climate. Improving education and training to include these principles and concepts will lead to creating a learning environment that enables sustainable agriculture and increased self-reliance come closer to becoming a reality.

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