Using Problem-based Learning in Online Courses: A New Hope?[i]

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Abstract

In this chapter, I argue that instructional designers must use research and theory to guide them to new and justified instructional practices when designing e-learning. I introduce a well-established pedagogy, Problem-Based Learning (PBL), in which complex, ill-structured problems serve as the context and stimulus for learning and students work collaboratively to understand the problem and learn about the broader related concepts. I describe the structure of PBL and discuss Barrow's (1998) concept of "authentic" PBL. I then review the support for PBL in the research literature and describe its relationship to cognitive and constructivist learning theory. I conclude the chapter by demonstrating how authentic PBL can be applied to e-learning using supporting examples from an undergraduate online course in Agriculture.

Introduction

Nichols & Anderson (2005, ¶ 12) make two important points about instructional design for e-learning:

1. E-learning pedagogies must be *defensible*, used with reference to proven educational practice and theory.
2. E-learning pedagogies are *evolving*. E-learning practice must make the most of new opportunities.

In designing e-learning, instructional designers must use research and theory to guide them to new and justified instructional practices. In this chapter, I examine the use in e-learning of a well-researched pedagogy, Problem-Based Learning (PBL), in which complex, ill-structured problems serve as the context and stimulus for learning. PBL contrasts with traditional subject based approaches where students are taught a body of knowledge and then apply what they have learned to sample problems. Students work collaboratively to identify what they need to learn to understand the problem and learn about the broader concepts related to the problem. PBL, therefore, encourages active participation by immersing students in a situation, requiring them to define their own learning needs within broad goals set by faculty, and searching for the knowledge needed to approach the problem.

PBL was developed the 1960's and used most widely in Medical Education. However, it has also been employed in such fields, as Nursing, Dentistry and Agriculture (Barrows, 1996, 1998; Boud & Faletti, 1991; Savery & Duffy, 2001). Research on PBL has focused on comparing PBL methods to more traditional instruction (Albanese, 2000; Albanese and Mitchell, 1993; Colliver, 2000; Smits, Verbeek & Buisonjé, 2002; Vernon

and Blake, 1993), rather than on the specific learning processes occurring in students engaged in PBL (Norman & Schmidt, 1992) or on the applicability to an online, Distance Education context, although there has been some recent work on what has been termed distributed problem-based learning (dPBL) (e.g., Barrows, 2002; Björck, 2002; Lehtinen, 2002; Lopez-Ortiz, B.I. & Lin, L., 2005; Lou, 2004; Liver & Omari, 2001; Orrill, 2002; Ronteltap & Eurelings; 2002).

Before we can consider PBL as viable for use in e-learning, we need to understand what it is. Therefore, I will begin with criteria for "authentic" PBL developed by Howard Barrows (Barrows, 1986, 1998), originator of the method, and present an example of how PBL is typically structured in face-to-face instruction.

Second, we should consider whether PBL is defensible. Is there evidence to indicate that PBL can facilitate learning in face-to-face settings? I will next examine the extensive literature on the effectiveness of PBL and review what light current learning theory sheds on the question.

Finally, even if PBL is effective in face-to-face instruction, does that mean that it can be applied in e-learning? In the remainder of the chapter, I will consider how PBL might be structured in online learning, arguably the most widely used form of e-learning. How would an online PBL course be structured? I will conclude the chapter by describing an online course developed for the Faculty of Land and Food Systems at the University of British Columbia and discuss how the critical features of face-to-face PBL were achieved in this context.

Online Learning and E-Learning

Massey & Zemsky (2004) suggest that there are three ways to view e-learning:

1. E-learning as Distance Education.
2. E-learning as course management systems.
3. E-learning as electronically mediated learning, providing interactive, but not necessarily remote, learning in a digital format.

If we accept Keegan's (1996) definition of Distance Education as the "quasi-permanent separation of the teacher and learner…" (p. 50), then the third view subsumes the first two and includes distributed learning [ii] and will, therefore, be accepted here. Moreover, since Kearsley (2005, p. xi), defines online education as the "use of networked computers to learn or teach", it can be seen as a sub-set of e-learning. This chapter, then, will focus specifically on online PBL as an exemplar of e-learning.

Is Your Instruction PBL?

Perhaps the most well known proponent of PBL is Howard Barrows, who pioneered its use at McMaster University in the 1960's in response to "the impoverished knowledge base that medical students accrued during their neurology clinical clerkships (residencies)" (Maudsley, 1999, p. 178). In response to an ever-evolving number of variations on PBL, Barrows (1998) defined "authentic PBL" to address several educational objectives:

1. Acquisition of deeply understood knowledge *integrated* from a variety of disciplines.
2. Development of effective clinical problem-solving.
3. Development of self-directed learning.

4. Development of team and interpersonal skills.
5. Development of a desire to continually learn.

To accomplish these goals, authentic PBL should have the several important characteristics:

Problem-based

PBL begins with the presentation of a real life (authentic) problem as might be encountered by practitioners. These problems consist of descriptions of events that need explanation and provide limited information (Norman & Schmidt, 1992). In medical education, they describe patients presenting complaints supplemented with some critical symptoms. In such areas as Nursing and Agriculture, learners are presented with problematic situations relevant to those fields. In all cases, learners then generate hypotheses about the cause of the problem to determine the important facts in the case and develop a solution. Norman and Schmidt (1992) provide the following example of a medical PBL problem:

> A 55-year-old woman lies crawling on the floor in obvious pain. The pain emerges in waves and extends from the right lumbar region to the right side of the groin and to the right leg.

In this case, students need to find an explanation of the source of the pain described, what physiological processes are occurring. and how it is extending to other areas of the body.

Problem-solving

Authentic PBL supports the application of problem-solving skills required in "clinical practice". The tutor facilitates the application and development of effective problem-solving process.

Student – centered

Students assume responsibility for their own learning and faculty act as facilitators. Teachers must avoid making students dependent on them for what they should learn and know (Barrows (1998).

Self-directed learning

Authentic PBL develops research skills. Students need to learn how to get information when it is needed and will be current, as this is an essential skill for professional performance.

Reflection

This takes place on completion of problem work and enhances transfer of learning to new problems. This is best accomplished through group discussions about what was learned with the problem, its essential elements, and how it relates to previously encountered problems (Barrows (1998).

Is PBL an Effective Instructional Strategy?

A review of the literature on PBL in face-to-face instructional settings leads to mixed conclusions. Several meta-analyses have been conducted over the last 12 years examining the use of PBL in Medical Education. While comparison research on media effectiveness has led to decades of no significance difference results (Clark, 1983, 1994;

Russell, 1999), these reviews have promise because they compare entire curricula using PBL or "traditional methods" over a period of several years.

Two early meta-analyses conducted are the most frequently cited as demonstrating that PBL is more effective than "traditional" methods of medical education (specifically lecture courses). Vernon and Blake (1993) found that PBL was superior with respect to students' clinical performance, but determined that PBL and traditional methods did not differ substantially on tests of factual knowledge. However, students taught using traditional methods did outperform their PBL counterparts on the US National Board of Medical Examiners (NMBE) Part 1 (basic science concepts) licence exam. Albanese and Blake (1993) produced similar findings. Students of conventional curricula outperformed PBL students on measures of basic science (NMBE Pt. 1), but PBL students scored higher on clinical examinations (e.g., NMBE Pt. 2).

Two recent studies (Dochy, Segers, Van den Bossche & Gijbels, 2003; Gijbels, Dochy, Van den Bossche, & Segers, 2005) produced similar overall results. Dochy et al. (2003) found a mild negative effect favouring traditional approaches for the assessment of student knowledge. However, these differences were encountered in first and second year of medical school and evened out in the last 2 years. PBL students gained slightly less knowledge but remembered more of it over time (retention). The results for skills consistently favoured the PBL curriculum.

Gijbels et al. (2005) examined the depth of student knowledge acquisition by applying Sugrue's (1995, as cited in Gijbels et al., 2005) integrated model of the cognitive components of problem-solving. This model proposes that learners' knowledge structures consist of three levels: a) understanding of concepts, b) understanding of the

principles linking concepts, and c) understanding the links from concepts and principles to conditions and procedures for application. Results supported PBL at all three levels but showed that it had the most positive effects when the constructs were being assessed at the level of understanding principles that link concepts.

So, is PBL effective? There appears to be some evidence for its effect over time when used in whole curricula, but, given the mixed results, it is uncertain that it would make any difference in instruction of shorter duration.

Is PBL Supported by Learning Theory?

Experimental research studies and quantitative review methods may permit relatively strong statements of certainty about effectiveness, but these statements are typically quite broad, e.g., PBL facilitates the learning of clinical reasoning skills. Such conclusions tell little about the cognitive processes underlying learning in such contexts and how specific instructional strategies affect such processes. For instance, Barrows and other proponents of PBL have argued strongly that this instructional approach sets the conditions for effective and deep learning of both disciplinary knowledge and problem-solving (e.g., Albanese, 2000; Barrows, 1998, Norman & Schmidt, 1992, 2000). Moreover, Barrows (1998) claimed that only “authentic” PBL could foster both the acquisition of a deeply understood knowledge *integrated* from a variety of disciplines and the development of effective clinical problem-solving. Does theory and research on human learning provide support for these claims?

Problem-Based Learning and Cognitive Theory

Albanese (2000) contended that information processing theory provided the most robust theoretical support for PBL. Broadly, this theory has three main elements, all commonly stressed in PBL: a) activation of prior knowledge, b) encoding specificity, and c) elaboration of knowledge.

Activation of prior knowledge. Learners recall and use knowledge they already possess to understand and structure new material-to-be-learned. PBL brainstorming, for example, can be used to trigger recall and prepare learners' cognitive structure for encoding the new material.

Encoding specificity. The closer the situation where something is learned resembles that in which it will be applied, the more likely transfer of learning will occur. PBL problems focus on real-life situations and present situations commonly seen in practice.

Elaboration of knowledge. Information is better understood and remembered if learners actively work with the material-to-be-learned. Elaboration includes strategies like discussion, spatial mapping, teaching peers and critiquing, all used in the PBL process

Problem-Based Learning and Constructivist Theory

While cognitive theory supports PBL, theorists have found stronger connections with Constructivist theory, which is currently in the ascendancy. Savory and Duffy (2001) consider PBL one of the best exemplars of a constructivist learning environment. In their view, Constructivism can be captured with three primary propositions:

1. Understanding is constructed individually through our interactions with the environment and we can only test how much our individual understandings are compatible.
2. Cognitive conflict is the stimulus for learning and determines the organization and nature of what is learned.
3. Knowledge evolves through social negotiation and through the evaluation of individual understandings.

Savory and Duffy (2001) identified eight principles for design of a constructivist learning environment and argued that PBL exemplifies all eight. Table 1 compares Duffy and Savory's principles to Barrow's characteristics of authentic PBL.

What is PBL Like in an Online Learning Context?

Can the transition be made from the use of PBL in a face-to-face context to its application in online learning?

Table 1.

A comparison of the characteristics of authentic PBL to Constructivist instructional principles.

Characteristics of Authentic PBL	**Constructivist Instructional Principles**
Problem - based	1. Anchor all learning activities to a larger task or problem. 2. Design the task and learning environment to reflect the complexity of the practice environment. Design an authentic task.
Problem-solving	3. Encourage testing ideas against alternative views and alternative contexts. Design the learning environment to support and challenge the learner's thinking.
Student-centred	Support the learner in developing ownership for the overall problem or task
Self-directed learning	Give the learner ownership of the process used to develop a solution.
Reflection	4. Provide opportunity for reflection on both the content learned and the learning process.

What are the critical factors for the design of “authentic’ online PBL? In the following section, I will overview the structure for an online course, Agro 260, AgroEcology, a

PBL course taught in the Faculty of Land and Food Systems at the University of British Columbia and assess each online design feature in terms of both Barrows' characteristics for authentic PBL and Savory and Duffy's (2001) constructivist principles. These courses were delivered using WebCT™ Campus Edition 3.8.

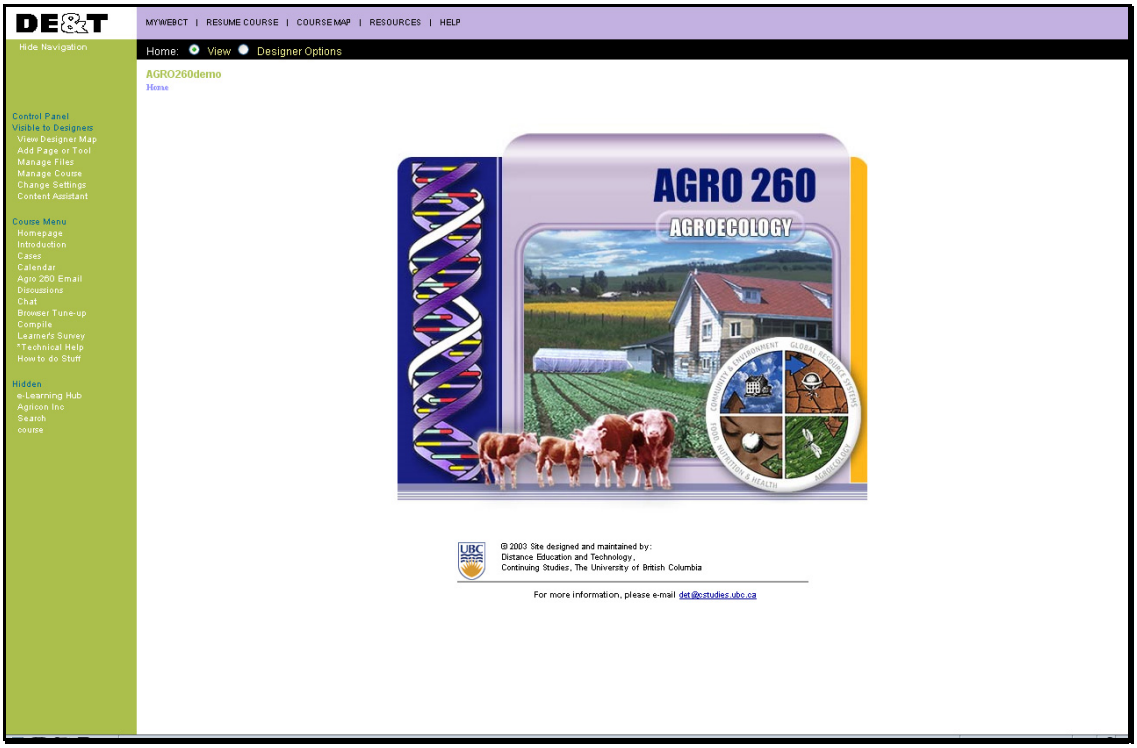


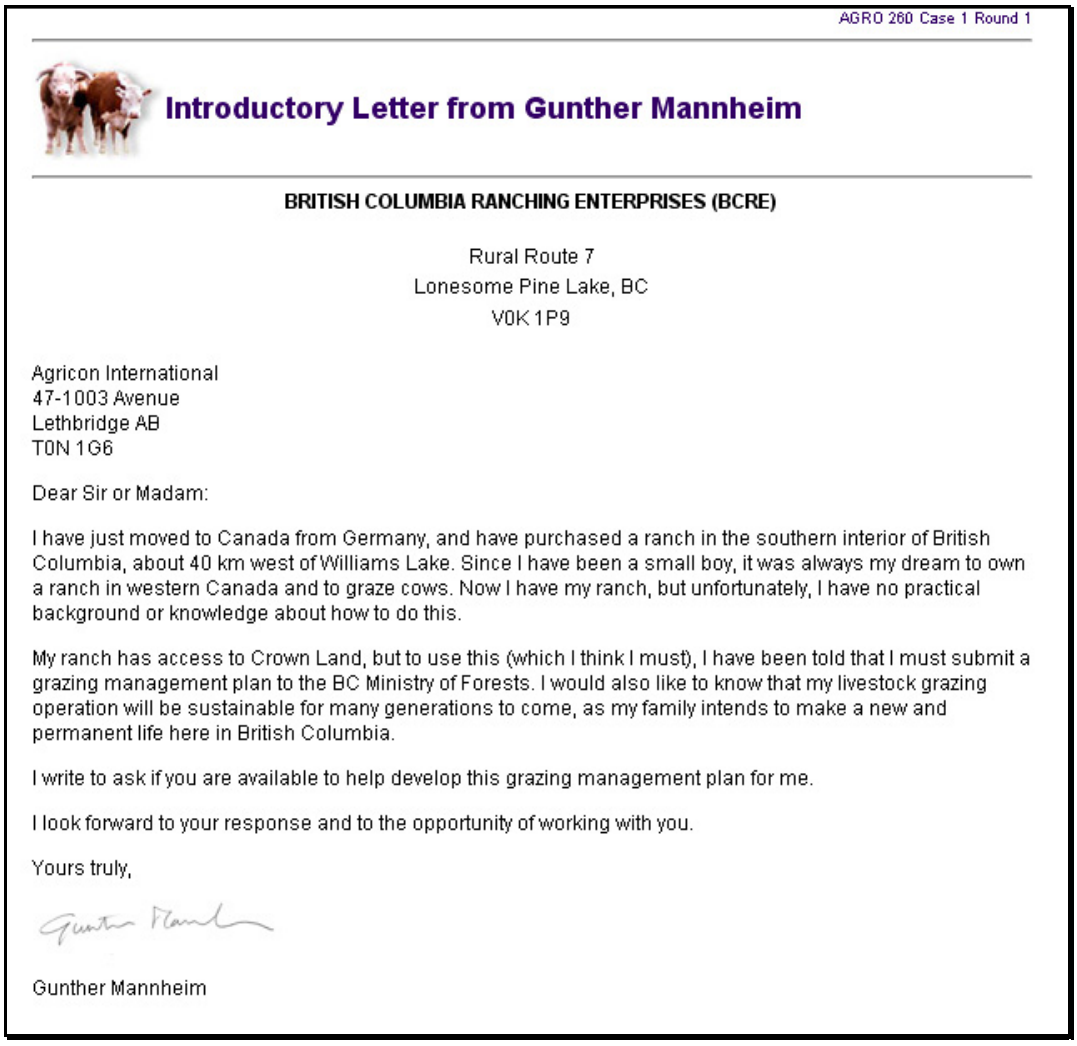
Figure 1. Agro 260 Splash Page

Incomplete Case Studies

Barrows (1998) states that PBL must be p*roblem – based,* i.e., begin with the presentation of a real life (authentic) problem stated as it might be encountered by practitioners. These problems describe sets of events that need explanation and provide only limited information. The course material in Agro 260 is introduced through four

cases concerning the practice of Agroecology: a) grazing ecosystems, b) organic vegetable production, c) tree fruit agroecosystems, and d) genetically modified organisms and rural communities. Students are asked to play the role of consultants to "clients" presented in the case and the course assignments are structured as consulting reports. All case activities flow directly from these cases and meet Savory & Duffy's (2001) constructivist principle of anchoring all learning activities to a larger task or problem.

Each case consists of multiple 'rounds', each including several disclosures. These introduce the problem that students are asked to address (Figure 2) or else provide more information (supplementary disclosures). In most cases, disclosures are made available as learners discuss the scenario and identify further information required. These case problems were carefully crafted to engage the students in the significant issues of this field and to ensure that they cover required content and, therefore, address Savory and Duffy's principles of authenticity and to reflect the complexity of the practice environment.



AGRO 260 Case 1 Round 1

Introductory Letter from Gunther Mannheim

BRITISH COLUMBIA RANCHING ENTERPRISES (BCRE)

Rural Route 7
Lonesome Pine Lake, BC
V0K 1P9

Agricon International
47-1003 Avenue
Lethbridge AB
T0N 1G6

Dear Sir or Madam:

I have just moved to Canada from Germany, and have purchased a ranch in the southern interior of British Columbia, about 40 km west of Williams Lake. Since I have been a small boy, it was always my dream to own a ranch in western Canada and to graze cows. Now I have my ranch, but unfortunately, I have no practical background or knowledge about how to do this.

My ranch has access to Crown Land, but to use this (which I think I must), I have been told that I must submit a grazing management plan to the BC Ministry of Forests. I would also like to know that my livestock grazing operation will be sustainable for many generations to come, as my family intends to make a new and permanent life here in British Columbia.

I write to ask if you are available to help develop this grazing management plan for me.

I look forward to your response and to the opportunity of working with you.

Yours truly,

Gunther Mannheim

Figure 2. Agro 260 Case 1 problem statement.

Asynchronous Discussion Forums for Process

Authentic PBL must be s*tudent-centred* (Barrows, 1998). Students assume responsibility for their own learning and faculty act as facilitators. In Agro 260, each PBL group uses an asynchronous Process and Evaluation Forum to review and discuss ground rules for collaboration as well as the overall process for conducting work within each working round. It provides an opportunity to define and critique the group process and to give individual feedback, separate from the content discussions in the working rounds

discussion forum (see below). Each group member must make at least one contribution to this forum in the first two (2) days of the case, when the ground rules are established. The forum remains open for the length of the case to allow group members and the tutor to raise concerns about how the group is working and how the case is proceeding. The use of process forums addresses Savory and Duffy's (2001) constructivist principle that PBL should support the learner in developing ownership for the overall problem or task

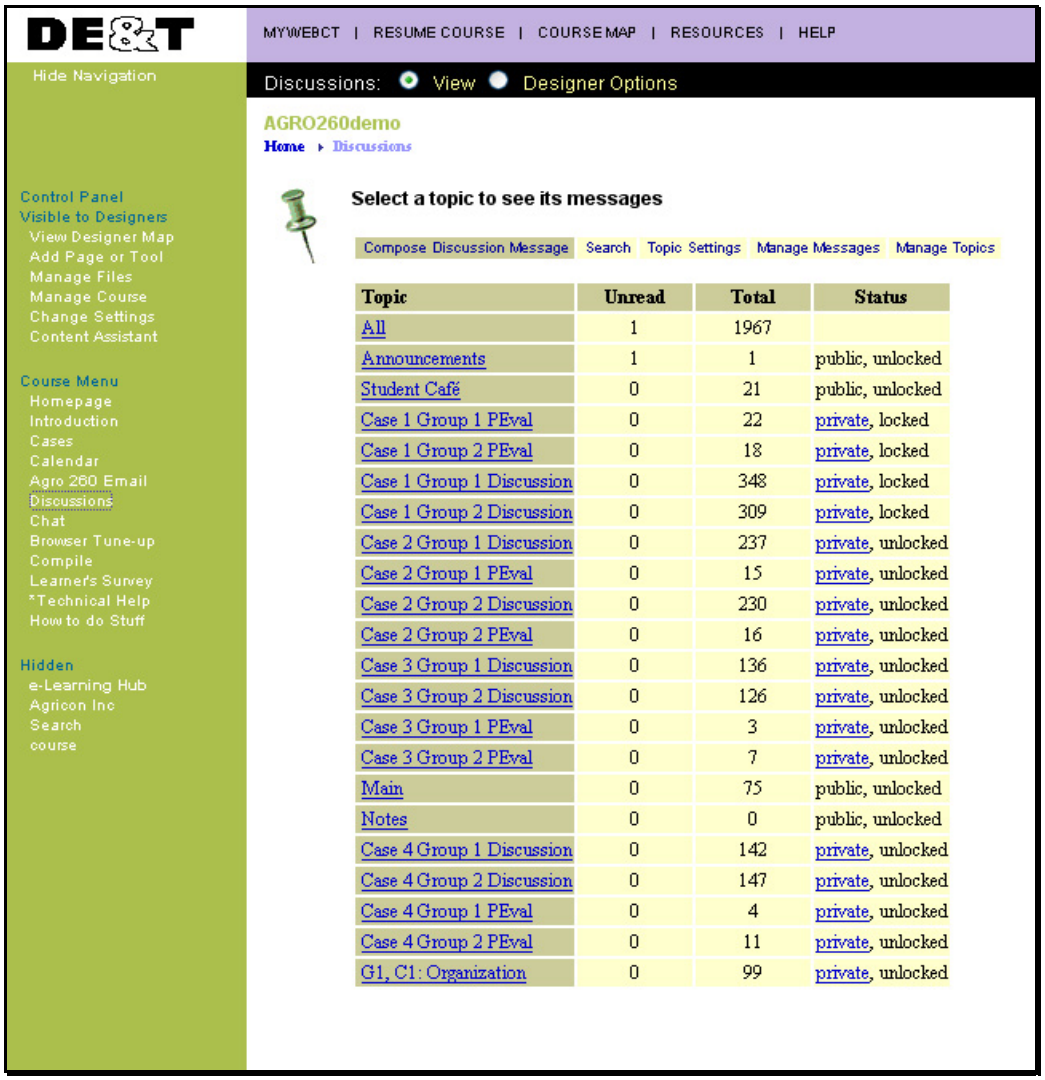


Figure 3. Agro 260 discussion groups.

Asynchronous Discussion Forums for Problem-Solving

Barrows (1998) stresses that authentic PBL problems support the application of *problem-solving* skills required in practice. The tutor facilitates the development of effective problem-solving process. In Agro 260, each scenario is accompanied by general guidance and discussion questions (Figure 4) to help the group identify the problem, what the learners already know to help solve the problem, and what further information they will need. Discussion questions help the group to identify *learning issues*, i.e., specific questions that group members will research.

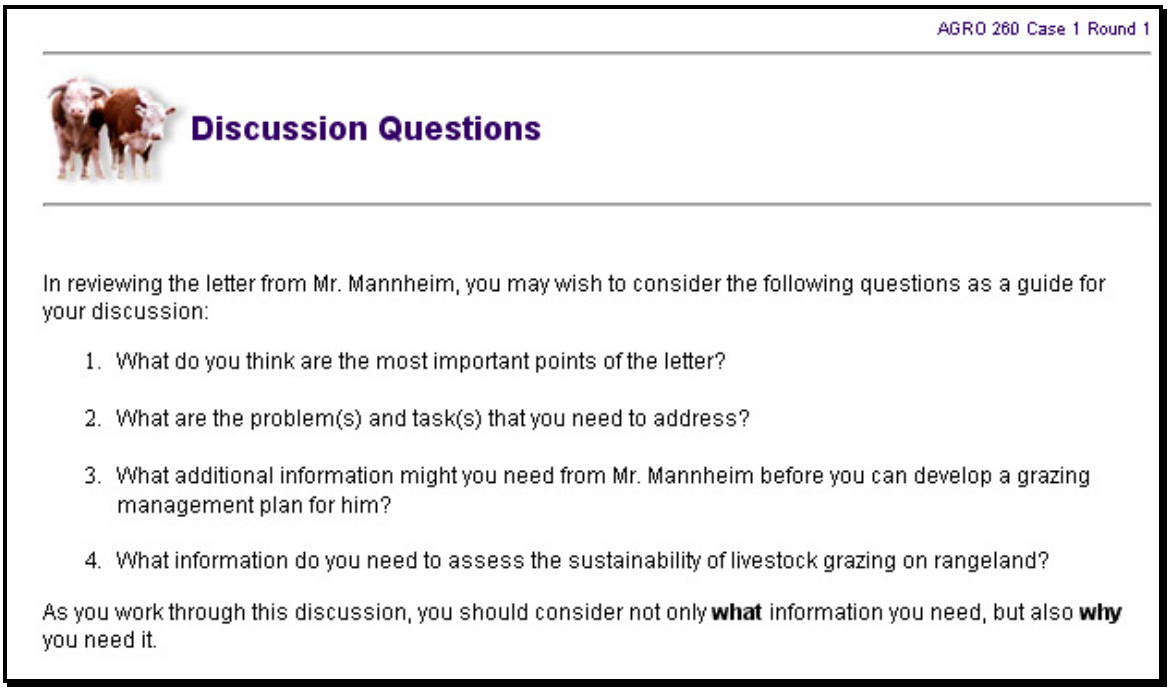


Figure 4. Agro 260 Case 1 discussion questions.

The discussion of these questions, identification of learning issues and reporting all take place in a separate (working) asynchronous forum. The working forum replaces face-to-face meetings where learners engage in such group processes as definition of the problem, development of working hypotheses, organization of the elements of the

problem, agreement on research tasks and reporting back on research completed. The tutor monitors the discussions and makes timely postings to encourage student participation, guides the discussion of controversial points, ensures that concepts are mastered, encourages depth of thinking and verifies the quality of resources used. The working forums then the application of Savory and Duffy's (2001) constructivist principles that the learning environment supports and challenges the learners' thinking and encourages testing ideas against alternative views and contexts.

Provision of Print-Based and Online Resources

To use authentic PBL, a course must provide for *self-directed learning* (Barrows, 1998). By this, he means that students must learn to locate current information when needed, as this is essential for professional performance. In this course, most of the resources needed are provided on the course website or via links to other web sites, especially governmental sites Figure 5). Students are also required to complete readings for each case from a purchased course textbook. In this regard, Agro 260 falls short of "authentic" PBL, since students are neither required to do much independent research nor taught how to do it and does not, therefore, adhere to Savory and Duffy's (2001) constructivist principles since the students are not given ownership of the research aspect of the process used to develop a solution.

However, in considering the transition to e-learning, we should be clear that this explicit provision of information was a choice of the course authors and not a restriction of the online learning context. Rather than to supply resources directly, it is certainly feasible to require learners to seek their own as would an individual engaged in practice. In fact, online learning using a learning management system affords learners easy access

to many electronic resources through research in libraries and other sources on the Internet and, while learners are not required to do the research themselves, Agro 260 makes abundant use of these sources of information.

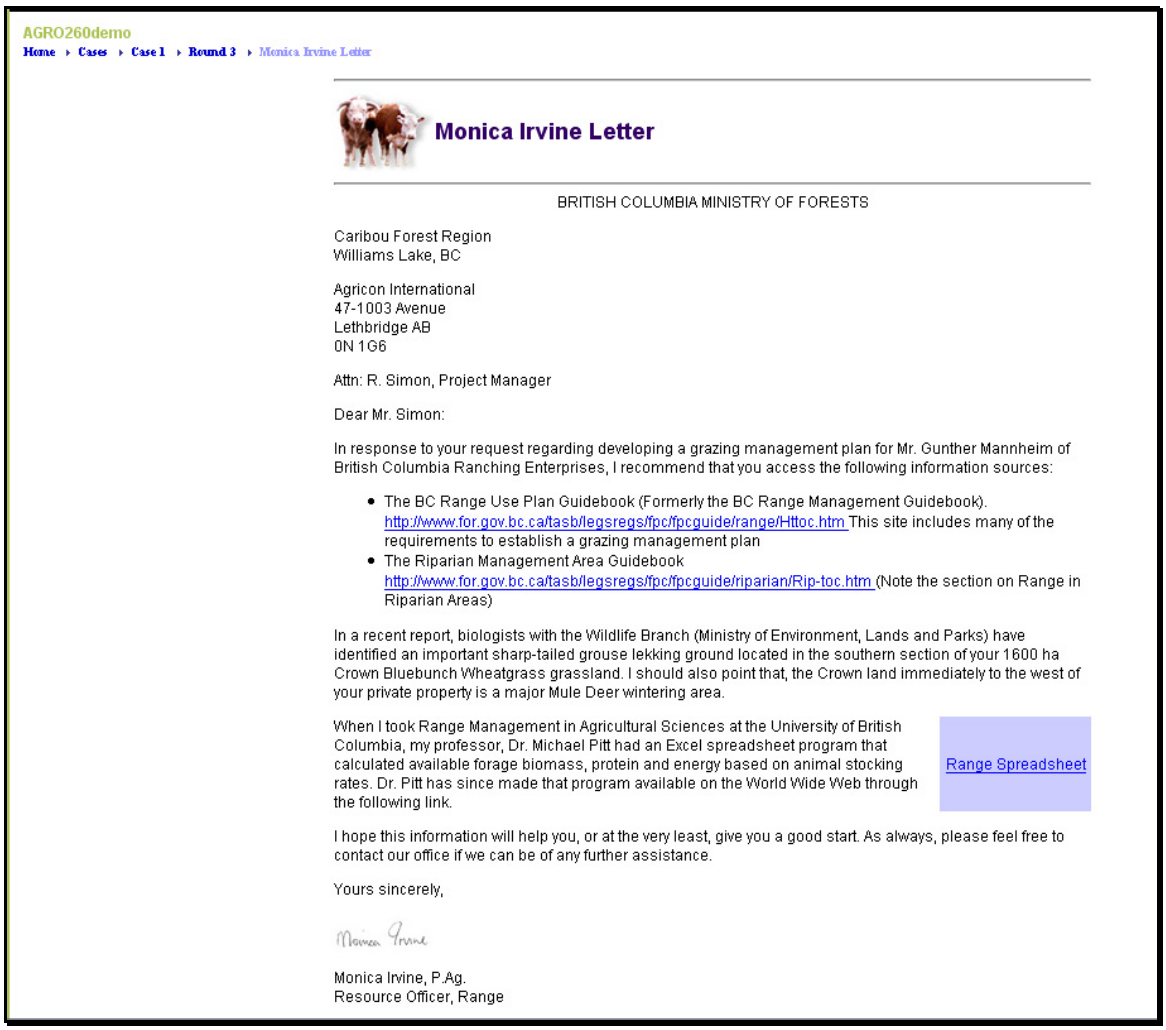


Figure 5. Agro 260 Case 1 supplementary disclosure providing online resources.

Assignments, Learning Objectives and Evaluation Forums

Barrows' (1998) final characteristic of PBL is *reflection*, which should take place following completion of problem work to enhance transfer of learning to new problems.

Barrows claims this is best accomplished through group discussions about what was learned with the problem, its essential elements, and how it relates to previously encountered problems.

Assignments. While the learning process in PBL is designed as a cooperative effort, student assessments in Agro 260 consist mainly of individual assignments and examinations. There is one group assignment in Case 1 (See Figure 6) requiring the collaborative effort of the group to develop a single submission. Otherwise, group members complete an individual assignments designed to address the problem(s) raised in the case after the PBL process has been completed. While the assignments are not based on group discussion, they do allow for reflection on the content in the case as per Savory and Duffy's (2001) constructivist principle that PBL provides opportunity for and supports reflection on both the content learned and the learning process.

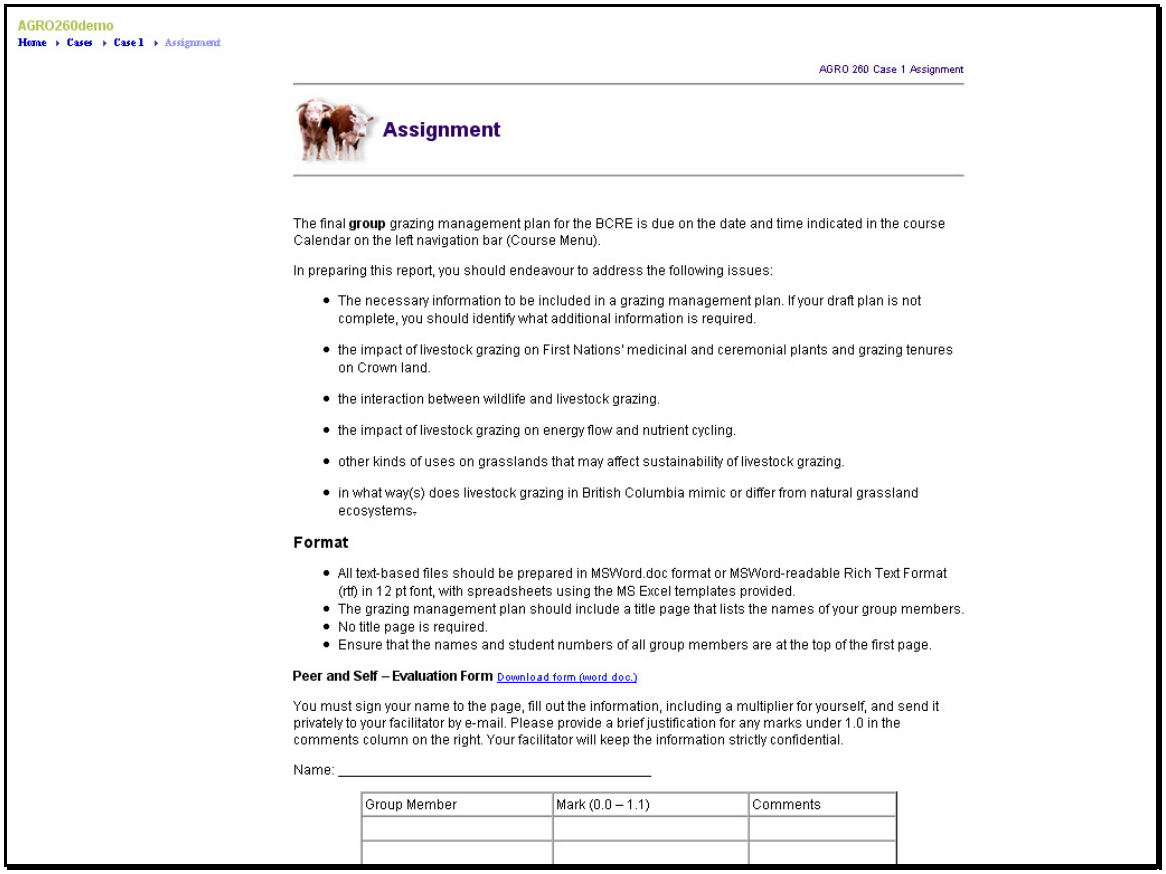


Figure 6. Agro 260 Assignment 1 (Case 1) instructions.

Learning objectives. On the final day of each case, the learning objectives for the case are made available via a time-released case icon and inform the students what they were expected to learn from the case. The final and mid-term exams are based on the learning objectives from all four cases. As is the case for the assignments, the provision of learning outcomes affords an opportunity to reflect back on the content, but also on the PBL process itself in the Evaluation Forum (below) in terms of what learning did or did not occur.

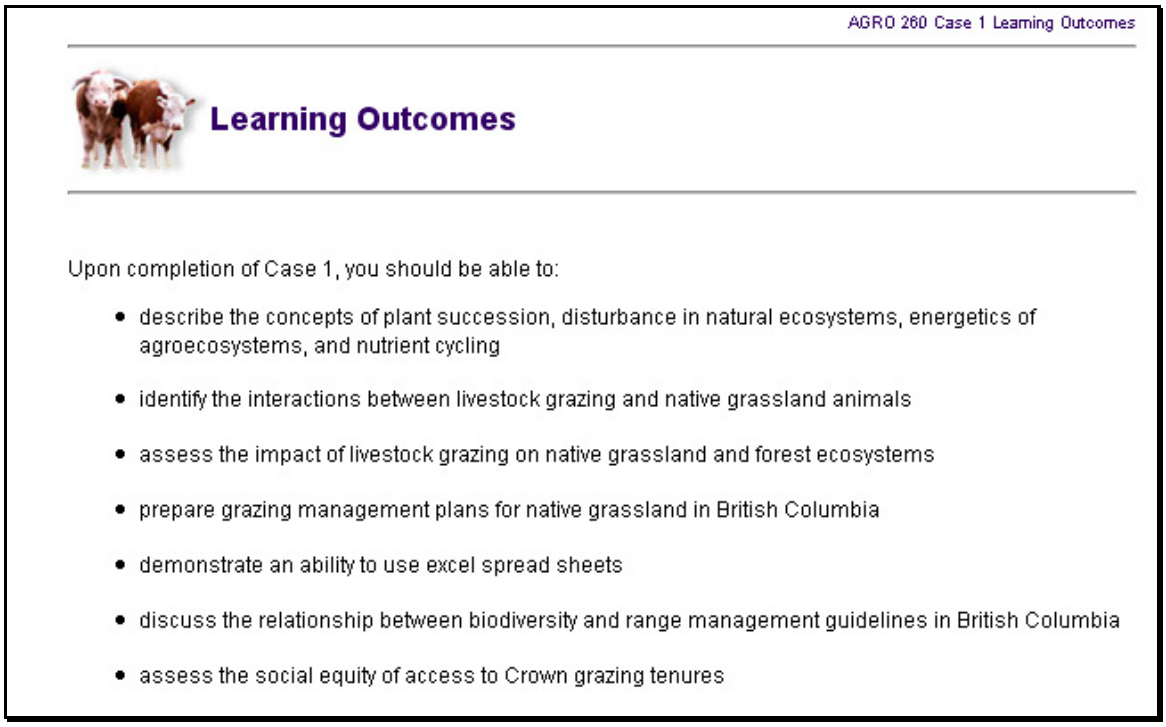


Figure 7. Agro 260 Case 1 learning outcomes.

Process and Evaluation Forum. This forum remains open for the length of the case. In Agro 260, there is also an evaluation component of this forum that assesses both group process and individual participation. It involves self- evaluation, peer- evaluation, and facilitator- evaluation, as well as an assessment of how well each student thinks his / her group is working. Participation is rated on a pass-fail basis. No marks are assigned for participation per se, but if a student's involvement is not rated as satisfactory, he or she fails the course regardless of the other marks assigned. These processes provide ample opportunity for reflection at the end of the case and, again, address Savory and Duffy's (2001) principle to support reflection on the learning process.

What Should You Consider When Implementing Online PBL?

The preceding description of Agro 260 and discussion of how research and theory applies to its instructional design provides one clear example of how the transition can be made from the use of PBL in face-to-face contexts to its application in e-learning. Not only is it possible to make the transition, but online PBL can provide opportunities that are more difficult to provide or unavailable in face-to-face contexts. However, online PBL can lead to some distinct challenges as well. I conclude this chapter with a brief discussion of some of the opportunities and challenges one faces in taking PBL online.

Opportunities Provided by Online PBL

Enriched authentic problem situations. In certain respects, the affordances of online and other computer-based environments are ideally suited to enhance the perception of authenticity of the problem situations. Video, audio, and photographs can be easily and efficiently delivered online and used to add realism to the presentation. For instance, in Agro 260, Case 1, learners develop a grazing plan for a novice rancher with property in the British Columbia interior. The "client" could have been introduced to the students in a video presentation to make the scenario seem less contrived and to foster interest in the problem. In terms of Keller's (1987a, as cited in Driscoll, 2005) ARCS model of motivational design, this can serve to gain attention to the problem and to enhance the relevance of the situation. In addition, video and photographs could also have been provided to show the property in question in order to clarify the extent of the problem situation and to make the situation more concrete for learners, that is, in

cognitive theory terms, to enhance activation of prior knowledge and encoding specificity.

However, when striving for increased realism, designers must avoid adding too much detail in the presentation of the problem statement since, in authentic PBL, self-directed learning is critical. Students need to learn to retrieve information when needed, as this is an essential skill for professional performance. They should remember that the increased use of media in online settings may also restrict access to learning. The use of streaming audio and video can increase requirements that learners access or acquire more powerful computer technology and connectivity options (e.g., cable or DSL Internet access rather than modem connection), which in turn makes the instruction more costly or even inaccessible for those in remote locations.

Efficient, flexible control over the PBL process. Online learning environments also afford immediacy and flexible control over the timing of instructional delivery. In face-to-face PBL, engagement in the PBL process is restricted to scheduled classes or to times when group members can arrange additional meetings. Subject to some of the challenges considered below, an online PBL process can be structured to proceed more continuously over the days and weeks of the course and to be available at times most convenient to the group members. Further, online learning affords the automatic time release of additional information in the form of controlled disclosures. In Agro 260, each case guides learners through multiple 'rounds' or stages of the problem. Each round provides supplementary information when learners are prepared to (or advised to) identify further information that they require. Again, a caveat is that the PBL process not

be so rigidly structured that it is totally instructor-centred and students are not engaged in a self-directed learning process.

Efficient provision of learning resources. Online learning environments can provide convenient and timely access to unlimited electronic resources in various formats. Learners can be supplied with materials in the environment itself or can be provided facilities for online searches. Such resources can greatly enhance learners' ability to effectively and efficiently search for and locate information required to help solve the problem at hand. In Agro 260, most of the resources students need to find a solution to the scenarios are provided in the course textbook, on the course website, or via links to other web sites. The advantage for learners is that the needed resources are readily available and they are, therefore, not required to expend much time searching for needed information.

Again, the trade-off is that the course authors may have done too much of the research for the learners and undermined the development of self-directed learning skills that PBL is supposed to foster. In providing learners with such a convenient and rich set of resources, Agro 260 may be too instructor-centred, since students are neither required to do much independent research nor taught how to do it.

Challenges Inherent in Online PBL

Engaging in PBL process using asynchronous tools. The PBL process in an asynchronous environment is much slower and less efficient than face-to-face discussion. While discussion in live classes is more or less instantaneous, in online PBL, learners have to access and read forum postings, compose and type in their reply, and then wait for an undetermined period of time for a reply. While asynchronous responses can be

nearly immediate if learners log on to the course website at the same time, at other times, fellow students may take days to reply and such time delays can negatively affect motivation to engage in the task at hand as well as to delay the group's progress.

However, asynchronous conferencing, as used in Agro 260, has some potential advantages over face-to-face discussion. First, it is flexible. Within limits, learners can engage in the process on their own schedule. Second, it may afford more time for learners to consider and support their contributions than they would have in live discussion and, therefore, to engage in more thoughtful, in depth interactions. Third, in asynchronous (network-based) environments, all interactions are retained and visible to the group members and can serve as a joint point of reference to facilitate understanding during follow-up discussion (Lehtinen, 2002). In addition, such a record makes visible milestones in the group process when pivotal decisions occur.

Interestingly, Ronteltap & Eurelings (2002), in a study of dPBL (combined live and online study), noted that PBL students in face-to-face contexts expressed the need for more time for communication and the opportunity to explain or discuss their work provided them with renewed motivation. The addition of asynchronous tools, available permanently and for unlimited use, helped to remove restrictions to the communication process.

Engaging in PBL process using synchronous tools. Online PBL, however, is not limited to asynchronous tools. Audio-conferencing software and chat tools allow for synchronous (real time) audio conversation and document-sharing and share many of the advantages of face-to-face PBL sessions. They afford the speed of interaction and efficiency of real time verbal discussions and more readily permit efficient participation

in such learning processes as brainstorming and group development of hypotheses. They even provide one advantage over live discussions in providing for the automatic recording of those discussions for later review.

Nevertheless, synchronous online interactions also have disadvantages. Participants lack the visual cues of face-to-face encounters and may find the interactions more stilted and impersonal. Such tools also depend on the quality of the technology available and technical difficulties can easily impact such sessions. In addition, their use with the use of audio and visual materials may affect learner access to learning by increasing technology requirements. Finally, synchronous sessions require participants to be online at the same time. This may lead to difficulties arranging sessions when learners reside in different countries and time zones.

One part of the online PBL process in which synchronous tools may be especially effective is fostering group reflection. Barrows (1998) advocates reflection following the completion of problem work to enhance transfer of learning to new problems and claims this is best accomplished through group discussions. In Agro 260, this process is accomplished using asynchronous conferencing and is the one part of the PBL process in which there is generally the lowest participation. Students are required to contribute to the PBL discussions and research to pass the course and are assigned marks on the basis of assignments and exams. The reflection process, on the other hand, mainly consists of the tutor's feedback at the end of the case on how well the group (and individuals) engaged in the PBL process and there is no requirement that students reply. This is one activity that might be enhanced by a synchronous audio post conference in which

learners are required to participate and where the efficiency of verbal communication might afford more through reflection as stipulated by authentic PBL.

Should You Take the Plunge?

While various learning tools can support the productivity of PBL in an online setting, technical capability is not the critical issue in making the transition from its use in face-to-face learning contexts. Most important is how such tools are used. The learning behaviour of the students involved in the process is influenced by much more than the functionality of the technology (Ronteltap & Eurelings, 2002). Many other factors come into play in small group tutorial learning such as PBL and apply equally to live and online instructional situations. These factors include the careful selection and design of the problems presented to students (Barrows, 1998), the fostering of strong teacher presence via active influence of the tutor on group process (Anderson, Rourke, Garrison, & Archer, 2001), and consideration of the cognitive processes elicited by small-group discussion (Schmidt & Moust, 2002) and the level of cognitive activity engendered in the learners (Ronteltap & Eurelings, 2002). To effect a full transition of PBL to e-learning, you need to look beyond the lure of the technology and keep in mind that, however it is delivered, PBL is first and foremost a specific pedagogy and be sure that you take into account the influence of these factors in the process.

Acknowledgement

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[i] With apologies to Star Wars fans everywhere! I considered the title, "Online Problem-Based Learning: a New Hope or the Empire Strikes Back?" – but that was too tacky…

[ii] Dede (1996, p. 6) defines distributed learning as "educational activities orchestrated via information technology across classrooms, workplaces, homes, and community settings and based on a mixture of presentational and 'constructivist' pedagogies."