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Putting Blended Learning to Work: a case study from a multinational oil company

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ABSTRACT *Blended learning can be operationalised in many different ways. At Shell International Exploration and Production, a form of blended learning focusing on learning while in the workplace through work-based activities within technology-supported courses has been evolving since 2000, with approximately 100 different learning events reflecting this form in 2004. After a review of the general approach to blended learning ('putting learning to work') that steers blended learning at Shell EP and the rationale for work-based activities that serve as the tools for 'putting learning to work' within these courses, a case study of the course 'Production System Optimisation', including a variety of types of evaluation data, is described. With this case as a point of reference, some reflections on the implications of work-based activities as a key tool for blended learning conclude the article.*

Dimensions and Design for Workplace-Oriented Blended Learning

Blended learning as the idea of the explicit substitution of some face-to-face contact sessions with study supported by a web-based environment while remaining at home or in the workplace is becoming familiar in corporate learning (Rossett *et al*., 2003). However, as Rossett and her colleagues show, location should not be the only focus for blends. In this section we identify various dimensions around which blending can occur in the corporate setting and a set of design criteria reflecting those dimensions.

Dimensions of Blending

There are many approaches to blending for corporate learning. March (2001) suggests combinations of live instruction and self-paced learning but extends this with tools for building a learning community, including chat, instant messaging,

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and newsgroup. While she lists the strengths and features of each type of approach and provides a worksheet for making decisions about what combinations of blend to choose, she does not relate the choice to either an educational model or the strategic vision of the corporation with respect to learning. Others discuss possible blend components from the needs of a particular professional community, such as Hesthammer (2003) who considers the needs of geoscientists and identifies a number of learning activities that can be aided by computer technology that could be combined in a single event or over time for the learning progression of the professional in this domain. These activities include using a learning-content management system or portal for access to individual learning resources, interacting with multimedia e-modules, using computer-based geo-simulators and participating in field trips with groups organised around problem-based learning. Both of these are typical of 'pick and mix' approaches (Clark, 2003) either within a course or spanning courses and other types of learning in the workplace. Valiathan (2002), in contrast, categorises blended learning in terms of its motivation: (a) skill driven, combining self-paced learning with facilitator support; (b) attitude-driven, for developing different attitudes and behaviours through events such as web-based seminars and group projects; and (c) competency driven, involving the observation of experts on the job coupled with use of knowledge-sharing tools. This approach interprets delivery methods in a broad way and includes the possibility of components in a blend that were not necessarily designed explicitly for learning. As a final example, some see blended learning in a more-visionary way in the organisation: 'we must go further, blending e-learning into corporate communications, workplace learning, marketing, recruitment, customer learning, searches on the web and the real world. This expansive view…offers exciting new approaches to blended learning' (Clark, 2003, p. 6). However, despite perspectives such as Valiathan's and Clark's, the typical orientation in practice for blended learning is as a combination of different locations for learning with various instructional methods or modes (Margaryan & Bianco, 2002).

Blends can become more complicated when one sort of blend is nested within another. This is the case when blends of instructional methods intersect with blends of formal and informal learning within a course setting. *Formal learning* involves a structured event supported by an instructor/facilitator or self-paced through instructional materials. Among the strengths of formal learning are: guided opportunities to learn while interacting with fellow course mates, broadening the learner's contacts beyond his or her workplace; quality controlled and pre-structured content; and learning events that are well defined in terms of time and scope. In contrast, *informal learning* is learning that takes place in the work context and arises both from participation—doing the work—and from social interactions with peers and experts in the workplace as well as from access to knowledge-sharing resources in the company such as best-practices databases or the conferencing environments of communities of practice (Van Unnik, 2004). Among the strengths of informal learning in the workplace are the anchoring of learning in problems and work-based tasks that are real-life and relevant to the learner, opportunities for modelling and coaching from peers and in-house experts, use of tools and data that are locally

relevant and development of self-direction for learning (Billett, 2001). The key to blending formal and informal learning within a course is to maximise the strengths of each within a course's design. A course is structured around key instructional design principles but after this involves as much as possible the tools, methods and mindset of informal learning in the workplace. This approach to blended learning could be called 'putting learning to work'.

Course Design for Blends of Formal and Informal Learning

In any combination of blends, principles of good learning for adult professionals should apply. Merrill (2002) has identified five 'first principles' of instruction which should apply regardless of what blend is chosen. He argues that:

> *Learning is promoted when:*
>
> 1. *Learners are engaged in solving real-world problems.*
> 2. *Existing knowledge is activated as a foundation for new knowledge.*
> 3. *New knowledge is demonstrated to the learner.*
> 4. *New knowledge is applied by the learner.*
> 5. *New knowledge is integrated into the learner's world. (Merrill, 2002, pp. 44–5)*

Merrill's principles show that adult professional learning should extend beyond pre-structured knowledge transfer. In the corporate-learning context, learning also should be characterised by creating and sharing knowledge, capturing and reusing experiences and the tacit knowledge and know-how within the organisation, and being able to solve workplace problems in a process-oriented, collaborative manner (Billett, 2001; Collis & Margaryan, 2004). In addition, the more realistic and workplace-focused the learning, the more flexibility is required in the learning environment. Flexibility relates to tailoring for individual differences and needs, not only in the time, place and pace of learning but also in the individual and intellectual diversity of the learner (e.g. differences in backgrounds, communication styles, learning styles and preferred ways of interacting with others) which becomes critically important when participants are from a variety of regions and cultures (Hofstede, 1991). For all of this to occur, the participants need to have a common electronic learning environment which integrates their course materials and processes as well as their tools and resources for informal learning.

Combining these aspects leads to a set of guidelines for how to design a blend for courses in multinational organisations where the processes of informal learning involving knowledge sharing and construction in the workplace around real work experiences are important components.

1. Begin with Merrill's five 'first principles' (2002):
    - Anchoring learning in relevant problems
    - Activation of prior knowledge
    - Demonstration by others with experience

- Application to one's own work and
- Integration with one's own work

2. And systematically add to these:

- Blends of opportunities for learning from others in the course and outside through collaboration and by comparing and contrasting different responses to similar/different problems
- Blends of opportunities for learning from the experiences of others, in the course, in the participant's own workplace and in the company more broadly through the use and reuse of resources for informal learning from the business
- Blends of learning activities that leverage the diversity and individual characteristics of the participants
- Blends of different types of interactions with persons involved in the learning, including workplace supervisors and other 'learning partners' who are not themselves course instructors or participants but play important roles in the work-based activities
- Blends of appropriate features of web tools and environments.

The integrating element for these blends of formal and informal learning could be work-based activities. Work-based activities are learning activities that are situated and anchored in real-world practice and that are focused on developing learners' ability to solve the problems of their everyday professional job roles. In contrast to well-defined 'textbook' problems, work-based problems are complex and ill-defined and need to be solved in social settings using tools and methods of both formal and informal learning, involving others for team working, and with coaching and scaffolding by persons with relevant experience (even including fellow learners). While the workplace location is necessary for this sort of work-oriented learning, a classroom or other form of face-to-face setting becomes optional.

In this paper we describe an example in which these guidelines for blending formal and informal learning were applied to fit the needs, strategy and culture of a multinational organisation and describe how the blend was implemented via the use of work-based activities. This is the focus of the next section.

Context Analysis: Shell Exploration and Production

Courses for technical professionals at Shell Exploration and Production can be used to illustrate how blends of formal and informal learning involving work-based activities can be realised in practice. First an overview of the context is given, followed by the description of a particular course.

Corporate Setting

The Royal Dutch/Shell Group includes five core businesses, including Exploration and Production (Shell EP). The activities of Shell EP include exploring, assessing

and producing hydrocarbon reserves in over 40 countries. Shell EP employs over 25,000 people (www.shell.com), most of whom are graduate technical professionals in areas related to petroleum discovery, extraction and production optimisation. They are well engineers, field engineers, production engineers, petroleum engineers, geologists and graduates of other geosciences disciplines.

Business Challenges

Like other multinational energy companies, Shell EP is facing two important challenges. On the one hand, the technologies and skill sets that are needed for exploration and production activities are continually changing. On the other hand, the company will experience a large 'crew change' in the next decade: experienced technical professionals will be retiring and newly hired staff will come from much more varied regional, cultural and professional backgrounds than is currently the case. To anticipate this, those with experience need to intensify their practices of sharing their experiences with their colleagues with less experience and coaching them as they work on processes comparatively new to them. These challenges have led to a redesign of the approach to learning for the Shell EP technical professionals.

Learning-Support Processes in Shell EP

The Shell EP technical professionals complete a foundation training consisting of a series of courses within their first five years of employment, and after this advanced training is available aimed at updating and advancing their competencies (SIEP B.V., 2002). Within as well as outside these structured courses the Shell EP professionals can make use of specific knowledge-management tools, virtual team-working strategies and coaching and mentoring programmes for informal learning or integrated within blended courses. Support for the blend of learning approaches is the responsibility of a particular organisation within Shell EP, called Learning, Leadership and Development (LLD), which is positioned within the human resources department. The LLD organisation has a matrix structure in which subject-matter experts in three main discipline areas (Sub-surface, Surface and Business & Leadership) work together with learning experts, an instructional-design team, knowledge-management experts, coaching and mentoring experts, a research team, a learning value-assurance team, an IT team and experts in organisational change. In total about 100 people work for Shell EP LLD. In 2003 Shell EP LLD offered about 250 instructor-led courses (classroom-only or blended) for a total of about 5500 technical professionals.

Shell EP LLD is responding to its business challenges involving rapidly changing technical knowledge and the need to stimulate more knowledge sharing within the company by introducing a new global learning strategy. The strategy emphasises the integration of formal and informal learning, where resources and contacts available via the knowledge-management systems or in the workplace are used within courses, and where courses are designed around blends of work-based activities. Coaching from supervisors and others in the workplace are important

components of the Shell EP blends. Technology is used to leverage this new approach. A web-based course management system developed by the University of Twente, the TeleTOP system, is used (Collis & Moonen, 2001; http://www.teletop.nl/teletop.nsf/home/en).

Since 2002 courses have been being redesigned around a form of blended learning that reflects this strategy. A course-design methodology and tools are evolving to support this large-scale redesign initiative (Bianco *et al*., 2002). All of the criteria discussed earlier in this paper are used to guide the course-design process. Approximately 70 courses have been redesigned, and have run through more than 100 cycles while all the other courses are systematically moving to blended form. The Shell EP blended courses can take different forms in terms of location blends: entirely done while in the workplace or workplace combined with a face-to-face component. The blend of group and individual activities is also important. Different blends of work-based activities are the key.

To make the description concrete, a particular course will be discussed in the next section.

Case Study: the course 'Production System Optimisation'

Although the 'blended' courses at Shell EP differ among each other, a specific course can still illustrate the ways that work-based activities and workplace learning are blended with other forms of learning. Such a description follows along with a summary of evaluation data and the use of the evaluation data for an after-action review showing how the course instructor can set new targets for the course blends during its next cycle of implementation.

Introduction to the Course

The Production System Optimisation (PSO – P310) course focuses on the knowledge and skills needed to optimise hydrocarbon production and fight production decline given the characteristics of a particular oilfield. The participants (as described in the course website) are production engineers with an average of 10–15 years' experience, 'who are involved in operating assets and are in a position to make a substantial difference in the performance of their oil fields'. Suitable candidates are not only from the production engineering skill pool, but also from other disciplines such as: process, field and reservoir engineers; field supervisors; team leaders; and asset managers. Appropriately skilled people in the different disciplines need to be able to work together to perform 'integrated production system optimisation'. They therefore need the skills to collect and evaluate field data and monitor and analyse system performance. Also, in a team setting, the professionals involved need to be able creatively to identify improvements, estimate how much the improvements are worth and prioritise work—with limited data. And, because they are professionals, they need to be able to communicate effectively and to contribute to the on-going development of a community of practice in their disciplines. All this together calls for a mindset oriented towards problem solving, learning from and working with

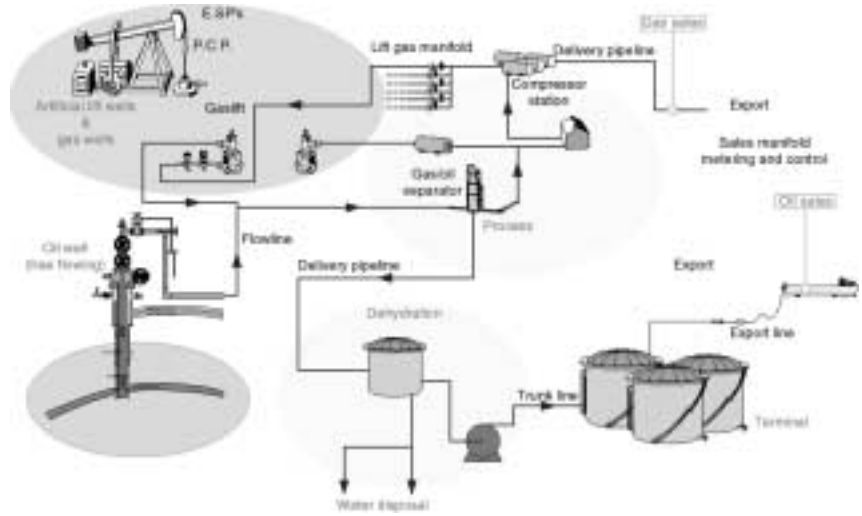

FIG. 1. Overview of the domain of production system optimisation.

others, and innovative thinking. Strengthening the development of this mindset is the underlying objective of the course. Figure 1 shows a schematic view of a production system, the domain focus of the course.

The objectives of the course include eight relating to the application of specific technical concepts, two relating to the facilitation and communication skills needed to negotiate with the many different suppliers of services and resources needed for a production system, and two relating to the need for professionals to contribute to the learning and coaching of others in their teams or their own communities of practice within the company beyond the specifics of the individual course. The course was redesigned at the end of 2003 in order to introduce more opportunities for blends of workplace experience and also to shorten the classroom session from two weeks to one week. The latter was realised by expanding the work-based activities outside the classroom. Also, as with all blended courses at Shell EP, a pre-course 'learning agreement' between the participant and his or her supervisor to anchor the course in a relevant workplace problem and a new course-evaluation approach to explore learning effectiveness and impact were introduced. The learning agreements and evaluation data were used as inputs for an after-action review between the instructors and the design and research teams.

The Course in Action

After receiving approval for participating in the course and having reached consensus on a learning agreement with their workplace supervisors relating to what their particular targets will be in the course, the participants receive an e-mail giving them the URL and password for the course web environment, accessible via the Internet. When the participants log in, they first see a 'News' message from the

instructor. This first message sets the tone for their participation. Portions are reproduced here:

> ***Welcome to the course!***
>
> *I'm very pleased to be working with you. Production System Optimisation is one of my favourite subjects and I have been doing this on and off for the past 20 years as a Production Technologist (PT) in different locations within Shell EP.*
>
> *My original role in PSO was as the team leader for the Gas Lift Team in…[the instructor describes his background in the company]. As an instructor for much of the past 7 years, I also have some facilitation skills….So, I know quite a bit about PSO. Having said that, I am certain to learn about PSO from you during this course. It is a very big topic….*
>
> *Once your pre-work is done in your workplaces, I promise to do my best to make the classroom event interesting and interactive. My goal as an instructor is to minimise lecture time in the classroom and maximise the action, interaction, and practice. This is how skills are developed. I've never known anyone to learn a skill by listening to a teacher. We will be practicing PSO throughout the course.*

This message introduces at least three of Merrill's first principles of instruction: real problems, demonstration and building upon the learner's experience. It also introduces the basis for a number of blends of formal and informal learning, including learning from each other. The instructor clearly designates himself as someone who will learn from the experiences of others in the course even though he has extensive experience in his own right.

Description of the Course Blends

The general organisational form of the blends in the course is described to the participants in the course website:

> *The course is a blend of three parts as follows:*
>
> ***Pre-work***
>
> *The pre-work is done here in the 'TeleTOP' environment. The aims are:*
>
> *—to add value to the learning process by having you share your experience with each other before as well as during the classroom sessions;*
>
> *—to shorten the classroom event (which was 2 weeks) making it practical to deliver to a wider audience at a lower cost;*
>
> *—to ensure you are all at the same level even though you represent a variety of specializations, which will increase the value of the course to you and the business;*
>
> *—to introduce us all to each other and allow us to become a bit familiar before the course.*

Classroom Event

This is the main body of the programme and is a 1-week face-to-face event. You will build upon your submissions from the first portion of the course and in addition work in teams to simulate some key PSO processes.

Post-work

Using TeleTOP, this part of the course is dedicated to implementing your work and learning from the programme when you are back in your work-places. For some this will be preparation for a promotion to a higher job level. For others it may be more related to your role in the implementation of production system optimization. We can define this together in the class and with your leadership. Using TeleTOP, you will complete the programme by submitting your post work.

This description of the blends focuses on the locations of the three components of the course but clearly links the components with the direct work situations of the participants.

Work-Based Activities in the First Portion of the Course

All instructions for the work-based activities for the first portion of the course are found in the portion of the web environment called 'the roster'. The 'roster' in a TeleTOP site is a matrix-type template that the instructor can set up in any arrangement of rows and columns, including rows that are only visible to certain groups of participants. For the P310 course, the first portion of the course, done in the workplace, was organised according to the roster portion shown in Figure 2.

In Figure 2, the icons in the far-right column indicate the locations where participant submissions can be found, directly associated to the instructions and the associated study materials which are linked to the same row of the roster. Instructor and peer feedback are also directly attached to each submission. While a number of the first set of submissions relate to bringing all participants up to the same level with regard to basic content, several of the activities are explicit examples of work-based activities intended for sharing and knowledge construction later in the course. These include:

- The 'Moments of Discovery' activity in which participants prepare a presentation on a 'flash' of inspiration that they themselves have had with regard to some aspect of PSO that led to a 'real breakdown in your work and thinking'. These will be used in the classroom portion of the course for peer learning.
- An economics assignment in which participants contribute data from their own workplaces and interpret these in terms of new ways of thinking that they had not tried before
- The 'Minimum Standards' activity in which participants rate their own workplaces against a set of criteria specified by the company in terms of good practice for production system optimisation, and describe what they feel is the strongest

Assignment - time	Sessions & what's involved	Material	Assignments
1 - 45 min.	Introduction	TeleTop overview	Get Oriented.
			Learning Agreement
2 - 45 min.	"Moments of Discovery"		Poster Preparation work
3 - 1 hour	Basic Economics	Basic Economics	Economics Quiz
4 - 2 hours	Acceleration and Deferment Economics	Economics for PSO	Economics Assignment
5 - 30 min.	Minimum standard for PSO	Minimum Standards	Minimum Standards Assignment.
6 - 1 hour	Global Process for PSO	GP #34 - PSO	Global Process assignment
7 - 30 min.	Produce the Limit	PIL and PIL+	Question
8 - 1 hour	Tools for PSO		Describe a tool
9 - 30 min.	Brainstorming	Brainstorming doc Brainstorm ppt	Brainstorming Quiz
10- 1 hour	Facilitation	Facilitation Materials	
11-1.5 hours	Limit Diagram	Limit Diagram	Limit Diagram Problem
12- 30 min.	Management Feedback	Management Feedback Material	PIL Example

FIG. 2. Portion of the web-based course 'roster' for the first segment of the course, done while still in the workplace. The boxed area shows where participant submissions and instructor and/or peer feedback are available.

example from their own workplace that can lead to new ways of working for others in the course.

- The 'PSO Tool' activity, in which participants describe a tool or instrument involved in PSO in their own workplace which is not likely to be familiar to the other participants but could be useful to them in their work
- A contribution-type activity in which the participants describe in detail a case from their own workplace that can be used by others for learning and for compare-and-contrast activities.

Results from each of these activities are documented to display an appropriate level of professional communication and submitted into the course web environment, where the instructor gives feedback and a mark based on assessment criteria, and where the submissions can be reused during the course and after. The web environment is also used for model answers and for coaching the participants on their work-based activities. For example, for the 'Moments of Discovery' activity, the instructor added the following suggestions to the course web environment:

> *To give you some ideas, past participants have chosen topics for their posters that have included:*
>
> *—Getting to the solution of a problem*
> *—Recognising that there is a problem*

—Explaining the previously un-explained
—Discovery of novel techniques
—Helping others avoid your mistakes
—Optimisation success

One of my own stories is how I found a restriction in piping that was causing back pressure on a whole platform. Another is how I accidentally discovered a leak in a dual that led to an extra million barrels of production. One of the students in another course told about how he discovered that sabotage was responsible for a series of failed crane cables. Make sure, whatever you choose, that you were personally involved with the idea and explain how you came to the idea.

The instructor regularly stimulates the participants to share and learn from each other. For example, in the instructors for the 'PSO Tool' activity, the instructor introduces the activity by saying:

Since sharing practices about tools is important for those within the PSO process, I think now is a good time for us to begin to share….Try to choose a tool that the rest of us are unfamiliar with….Based on your own experience, give some hints and tips or practices worth replicating for the use of the PSO tool you describe for this exercise.

Each of these submissions represents an important sort of blend: the blend of real workplace data and problems, as identified and contributed by the participants for later sharing and further learning. With this approach, the differences in backgrounds, cultures and experiences of the participants are leveraged in that they become some of the main learning resources for the classroom portion of the course.

Classroom and Post-Classroom Portions

Figure 3 shows the roster for the classroom and post-classroom periods of the course.

When the participants come to the classroom, they build upon the various submissions that they have made from their workplace experiences during the first portion of the course. For example, when the participants present their 'Moments of Discovery', they do this in groups of four at a time, each presenting in a different corner of the room. The rest of the participants can rotate through two of the four presentations. Because they have studied the 'Moments of Discovery' submissions ahead of time via the website, they can choose the two presentations in each set of four that are most relevant for them and prepare some specific questions in advance. For the follow-up to the 'PSO tools' activity, the instructor collates all the tools that the participants indicate that they themselves have used, and bases the classroom discussions around their experiences. In the follow-up to the 'Minimal Standards Activity', the instructor prepares a chart indicating the range of the participants' self-rankings of their own workplaces and shows this overall chart to the group.

70			Classroom session - 5 days	Classroom Event	Typical PSG Classroom Agenda	
72			Classroom topic		Technical Hints and Tips	
74			Classroom topic		Healthcheck	
76			Classroom topic		Paint the Picture	
78			Classroom topic		Enabling Environment	
100			Post Class - Step 1	Big Picture Basis	Example	Describe your BPS
105			Post Class - Step 2	Limit Diagram Basis	Example	Create (part of) the Limit Diagram
110			Post Class - Step 3	Opportunities	Example	Opportunities identified
115			Post Class - Step 4	PIL+ Checklist	Example	Review Checklist
120			Post Class - Step 5	Pre-PIL+ Meeting	Agenda and action list	Meeting Results
200			PIL+ Output			PIL+ Result

FIG. 3. Portion of the web-based course 'roster' for the classroom and post-classroom segments of the course.

Participants can see immediately where their own ranking fell relative to each of the assessed categories in comparison with those of the other participants, and discuss with each other what the differences are in their workplaces that led to some having high scores and others low.

These follow-up activities are not the only activities during the classroom setting. The blend of activities includes four group activities. Three of these involve using a computer-based simulator of an oilfield, called SimField. The groups must deal with sets of data, enter the data appropriately in the simulation, interpret their results, make decisions based on these and defend their interpretations in a professional manner to the instructor, who plays the roles of SimField's engineers, managers and partners. Figure 4 shows one of the interfaces of the SimField software (designed and built by the instructor). The software is yet another example of a blend in the course: a blend in learning resources including real resources from the workplace but also a computer-based resource, the simulation software, which allows the participants to study within hours the results of complex processes that would take months to work through in reality and for which they would never have the opportunity to redo processes with new variables or undo mistakes in the actual workplace.

Following the SimField experience, the participants participate in a workshop environment to create company action plans for improving production system optimisation efforts. Then they prepare for the last, and major, assignment of the course. When they go back to their workplaces, they will analyse their own fields and submit an extensive report and action plan relating to their own work, using all the course experiences as guides. These reports, as seen in the roster in Figure 3, take place over a series of steps, each with a submission and with feedback from the instructor. The major activity concludes with a presentation, in the workplace, to the participant's workplace supervisor.

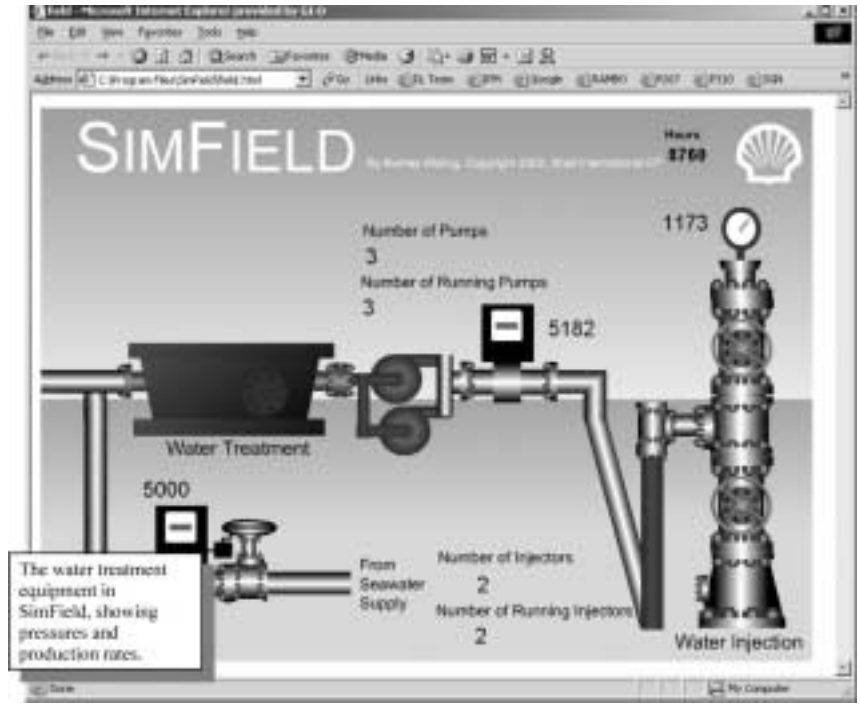

FIG. 4. One of the interfaces of the computer-based simulator, SimField.

Results of the Evaluation

Upon completion the course was evaluated via four instruments used to collect course-evaluation data at Shell EP LLD: a coding form for the 'learning agreements' between the supervisors and the participants from the start of the course; a 'course-scan' checklist, in which aspects of instructional design and use of technology are evaluated (Margaryan, 2004); a supervisor feedback form; and a participant feedback form (Collis & Margaryan, 2004). In addition, three months after the completion, a follow-up evaluation took place. The purpose of the follow-up evaluation was to explore participant and supervisor reactions once course participants had had time to use their learning back in their workplaces.

For the P310 course, data were collected via online surveys from 20 course participants (out of 23), 11 of their workplace supervisors, from the coding of 16 learning agreements and from the scan of the course web environment including all the study resources, activity management and communication outside the classroom sessions.

Through the use of these instruments a variety of data were analysed. Highlights of the results follow.

Results of the analysis of the learning agreements. The introduction of the learning agreement aimed both at encouraging a discussion between the course participant and his or her supervisor as well as collecting important evaluation data. Via the analyses of the learning agreements data were collected that showed that:

1. The course addressed participants' needs as expressed in the 'development plans' agreed with their managers
2. The course addressed an existing business need, although this was not always clearly expressed in the learning agreement
3. Application of learning in the workplace and impact on the business are expected, although not always clearly expressed in the learning agreement
4. Via the learning agreement course participants could often identify in advance work that could be carried out as an assignment
5. Most course participants had good workplace conditions (sufficient time, a quiet place, suitable network) to complete the course successfully.

Results of the course scan. Evaluation of the course design indicated particular strengths in the following areas:

1. Anchoring of the course in workplace problem (a composite score of 4.0 out of 5.0 on a set of relevant coding variables)
2. Opportunities for application of acquired knowledge and skills (a composite score of 4.0 out of 5.0)
3. Effective use of the functionalities of the web-support environment (a composite score of 4.0 out of 5.0).

Some areas for improvement were identified as well, such as:

1. Increasing the stimulation to learn from the larger corporate community via making use of the Shell EP 'Global Networks' (discussion environments for in-house communities of practice) (Van Unnik, 2004) and other in-house knowledge repositories
2. Further accommodation of learner diversity, particularly for learners from different cultural backgrounds and with different learning styles.

Results of the follow-up evaluation. The follow-up evaluation three months after the course involved responses from 13 participants and eight of their supervisors. Results showed that both participants and their line managers thought that the participants' competence levels had improved as a result of the course. Learning from the course had been successfully applied to actual workplace problems and the supervisor had been involved in supporting this. In addition, examples about the value and impact of learning were provided.

Overall results. Combining key results from the participant surveys, the supervisor surveys, the course scan, the interviews and the summary of the coding of the learning agreements led to a reduction of the data into seven basic categories.

- Core course design (relating to Merrill's five first principles, 2002)
- Strategic course design relating to the blends in the course (blends learning from others, reusing resources and experiences from the business, and leveraging the diversity of the participants)
- Supervisor involvement (learning agreements and other support)

- Web-environment design (website consistency, information completeness, use of communication features, organisation of resources and participant satisfaction)
- Participants' and their supervisors' perceptions of the participants' learning and changes in performance
- Participants' and their supervisors' perceptions of the business impact of the course
- Participants' satisfaction.

The overall evaluation results based on these categories are shown in Figure 5 where each composite score is shown in relation to an 'ideal' composite score of 5.0.

One of the objectives for redesigning this course was to reduce the amount of classroom time (and resultant course fee) while retaining (or improving) the quality. By adding a first component carried out in the workplace via the support of the web-based environment, the amount of classroom time was reduced by 50 per cent while retaining or improving course quality. The results shown in Figure 5 identified specific openings for improvement that were discussed by the instructor and the design and research teams during an after-action review of the course.

Further Improvements

Based on the lessons learned from the evaluation results the following improvements were suggested during the AAR and are being follow up by the instructor:

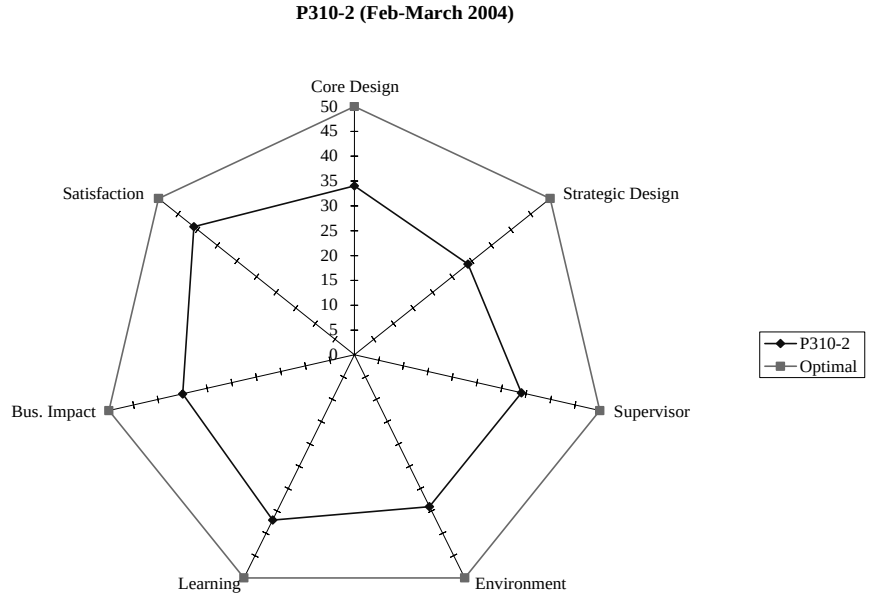

FIG. 5. Evaluation results for the PSO-P310 course – 1st run in 2004. Categories are: Core design (including Merrill's five first principles, 2002), Strategic design, Supervisor involvement, Web environment, Learning, Business impact and Satisfaction.

- Build further upon the learning agreement by designing more steps in the work-based activities that involve the supervisor, such as a check-back on the learning agreement, to occur before and/or after the classroom portion. At the same time support the use of the learning agreement by enhancing and expanding user guidelines for instructors, participants and supervisors and sharing success stories.
- Make more explicit use of the Shell EP knowledge-sharing system (Global Networks).
- Add more detailed assessments with grading of learner submissions, such as marking the analyses done of situations in their own workplaces in the third portion of the course. The assessment of this final analysis could be part of a final review of the learning contract by supervisor and participant.

Implications

For this form of blended learning that combines work-based activities carried out while in the workplace with a variety of other learning situations, there are several issues and challenges facing those involved: the learners, the instructors, the course designers and the workplace supervisors. Challenges include:

- For the instructor: it took considerable thought and creativity to develop the course approach but now the instructor handles the new roles within the course in a comfortable fashion. However, it may be difficult for other instructors to handle so many aspects, in such a capable manner. The instructor must also learn to coach through the course web environment when participants are in their workplaces and to handle online feedback and assessment in a manageable fashion.
- For the participants: this blended approach can help course participants to focus on relevant topics and apply learning back at work. However, certain conditions are needed for this: sufficient time, an adequate place to study and work on submissions and good network connections.
- For the workplace supervisor: within this course approach the supervisor is required to contribute to the learning agreement and the evaluation as stipulated by the course designers and instructors. In order to engage supervisors, a bottom-up approach such as one involving a learning agreement, needs to be blended with a company-wide top-down approach encouraging supervisor involvement by rewarding it, for example, via career progression. This is now happening in Shell EP, as the proposal has been made by senior management to include the supervisors' coaching skills in his or her job expectations.
- For the course designers: the approach described for this kind of blend of formal and informal learning requires a major mindset shift from content design to activity design. The key is designing the course around real work-based problems, processes or opportunities so that the final product of the activity is something that is usable and useful in the workplace. In addition, the designers must acquire skill in the design of a course web environment to be used as support for

knowledge-sharing activities as well as a repository for materials submitted by the participants that can be reused as learning objects by others.

Conclusion

In the Shell EP context, the form of blended learning that is evolving has resulted in transfer of learning to the workplace being enhanced since this transfer is explicit in the course design. Content objects such as actual workplace documents are seen as resources for the activities and selected participant submissions are reused as valuable learning objects for others. In these ways the different experiences and backgrounds of the participants are leveraged and the 'crew change' anticipated via the emphasis on knowledge sharing and learning from each others' experiences.

In general, we believe that courses for professionals working in complex settings, such as engineers and geoscientists in the oil industry, can benefit from this type of well-designed and well-managed blend of formal and informal learning. While there still may be a classroom component to such a blended course, the main aspect is the blends involved in the work-based activities.

With learning driven by work-based problems, tasks and situations, the boundaries between 'formal' and 'informal' learning blur and take on new forms. A course becomes a guided opportunity to learn from and share experiences gained through work-based activities, and to contribute one's own experiences as learning resources for others for reuse in both formal and informal learning settings. Such learning environments supported by network technology create opportunities for learners to generate new ideas collaboratively while working on complex learning situations in their own workplaces. Collaboration and knowledge sharing occur among the peers in the course, peers in the workplace and between teams with similar problems but in different workplaces (in multinational organisations, these workplaces are often located in different parts of the world).

Thus blended learning can be much more than 'a range of course-delivery modes'. But, for this to occur, the blending must be in line with an organisation's strategy, needs and internal culture.

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REFERENCES

BIANCO, M., COLLIS, B., COOKE, A. & MARGARYAN, A. (2002) Instructor support for new learning approaches involving IT, *Staff and Educational Development International*, 6(2), pp. 129–48.

BILLETT, S. (2001) *Learning in the Workplace: strategies for effective practice* (Sydney, Allen & Unwin).

CLARK, D. (2003) Blended learning on-line, online at: www.epic.co.uk (accessed 7 November 2004).

COLLIS, B. & MARGARYAN, A. (2004) Criteria for evaluation of success of blended learning methodology, in: J. ESTIVAL & F. KETS (Eds) *Proceedings of the Workshop 'Blended Learning, a Learning Model for Geoscientists?'*, Paris, France, 66th Conference of the European Association of Engineers and Geoscientists (EAGE), pp. 1–5.

COLLIS, B. & MOONEN, J. (2001) *Flexible Learning in a Digital World: experiences and expectations* (London, Kogan Page).

HESTHAMMER, J. (2003) How modern technology can meet needs of modern learning in geoscience, *First Break*, 21, pp 23–9.

HOFSTEDE, G. (1991) *Cultures and Organisations: software of the mind* (New York, McGraw-Hill).

MARCH, J. (2001) How to design effective blended learning, on-line at: www.brandon-hall.com (7 November 2004)

MARGARYAN, A. (2004) Course scan: criteria for designing work-based learning, internal report, Shell EP Learning and Leadership Development, Noordwijkerhout, Netherlands.

MARGARYAN, A. & BIANCO, M. (2002) Blended learning: a benchmarking study, internal report, Shell EP Learning and Leadership Development, Noordwijkerhout, Netherlands.

MERRILL, D. (2002) First principles of instruction, *Educational Technology Research and Development*, 50(3), pp. 43–59.

ROSSETT, A., DOUGLIS, F. & FRAZE, R. V. (2003) Strategies for building blended learning, on-line at: http://www.learningcircuits.org/2003/jul2003/rossett.html (accessed 20 August 2003).

SIEP B.V. (2002) Learning guide, internal course catalogue, Shell EL Learning and Leadership Development, Noordwijkerhout, Netherlands.

VALIATHAN, P. (2002) Blended learning models, on-line at: www.learningcircuits.org/2002/aug2002/valiathan.html (accessed 8 November 2004).

VAN UNNIK, A. (2004) Benefits of developing knowledge sharing communities, paper presented at the 11th Abu Dhabi International Petroleum Exhibition and Conference, Abu Dhabi, United Arab Emirates, 11 October.