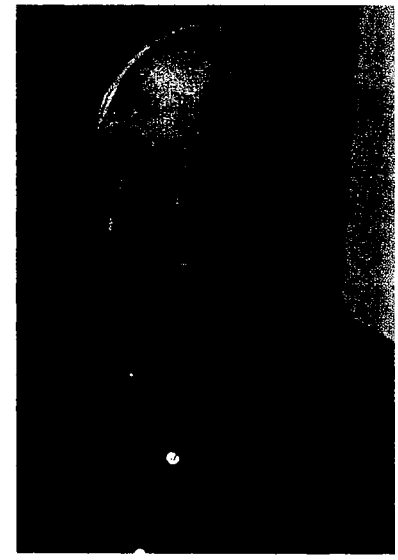
A **Framework** for Integrating **Learning** into **Business Processes**



By Igor Hawryszkiewycz
Department of Information Systems
University of Technology, Sydney

Abstract:
Integrating learning into business processes has the advantage of raising skill and knowledge levels of process participants in cost effective ways. To get this advantage, however, requires ways to go beyond current practice of standard learning modules into more personalized systems that address knowledge gaps on a just-in-time basis as they are discovered during process execution. In that case process participants need to learn in the context of their particular task. Current practices in learning and teaching have been towards learning in context, known as constructivist learning, which has similarities to business process needs. This paper will describe such practices and describe their application in a university environment. It will then suggest ways to transfer them into personalised practical contexts.

Keywords: Learning, Business Processes, Software Agents

1 Introduction

People in knowledge intensive processes must continually learn and adapt their activities to evolving process goals. Such work-based learning is particularly important in knowledge intensive processes, which include creation of new products and services (Grant, 1995), distributed project teams (Carmel, 1999), managing distributed communication systems (Ray, 2002), as well as design teams, planning, evaluation or client support teams. More and more organizations realize that learning while working is the most effective form of further education. It is cost effective, efficient and compatible to the working hours. Learning at work encourages knowledge acquisition from work relevant documents, and using the expertise of experienced workers. Work-based learning makes it possible for trainees to select reading material relevant to their work or be guided by direct contact with experienced colleagues. Such an approach to workplace learning offers knowledge management on demand, online training, quality assortment and certification and performance improvement.

It is of course true that there is already considerable computer support for learning within business. Much of this, however, concentrates on training in specific tasks for a large number of personnel. The paper examines ways to provide a more personalized approach to address current process needs. It will identify

alternate ways of integrating reusable learning components into business processes. This will enable them to quickly acquire new skills and knowledge in the context of their work without imposing undue costs on the organization. The paper will examine ways to add learning capabilities to business processes using current trends in learning theory and practice. These trends are moving to a business type environment as they emphasize the acquisition of skills (Hezemans and Ritzten, 2002) and constructivist approaches to learning in context (Jonassen, 2002). The trends are approaching practical environments, where virtually all learning takes place in a work context. The paper provides a basis for transferring practices between the two areas.

In particular the emphasis will be on the learner first identifying a learning gap, and then composing a workspace constructed of generic components to eliminate this gap. This will need knowledge of people's profiles to identify knowledge gaps and determine the kind of personalized support to be provided. One goal is to develop a platform for developing work experience and knowledge objects and provide assistance to make them available to business process participants. It will particularly draw on the idea of software agents as components to actively (Hawryszkiewycz, 2004) assist business process participants to select the most appropriate engagements to quickly address their knowledge gap. This paper suggests that such units of learning can be constructed and managed by software agents.

Figure 1 shows a systematic approach to developing flexible learning environments. The first step is to examine current trends in learning and teaching. Then a general conceptual model, which can be used to describe any number of practices and learning needs, is proposed. Such a model is used to identify the generic components, which can be customized to a variety of learning requirements. The conceptual model terms are then used to model particular learning requirements given a learning objective. A mapping is provided to convert these models to an implementation, usually a learning space. The paper:

- Defines the conceptual framework for describing learning environments,
- Ways to use the framework concepts to identify generic components, and
- Support tools to personalize learning to process participants using these components.

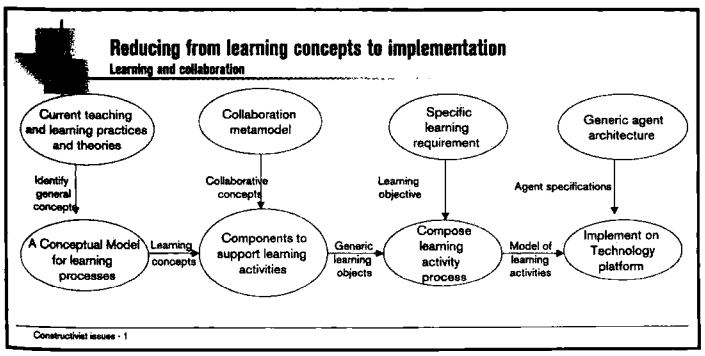


Figure 1 – Approach for designing learning systems

2 A way to define learning processes

A detailed outline of common educational theories is out of the scope of this paper. There is currently a trend from the instructivist approaches to constructivist approaches, which predominantly emphasize problem based learning. There is also considerable emphasis on learning environments that use learning objects. Learning objects provide flexible ways for providing instructional material that can be reused. The inclusion of learning objects within the business process will result in most learning taking place without requiring extensive use of existing process resources.

2.1 Learning objects

Learning objects have been proposed in answer to the need to share materials across learning environments and can provide a basis for constructing flexible systems. Learning objects are still a concept that needs some adjustment to a suitable implementation. Most standards such as the Dublin core [http://www.dublincore.org] and the Learning Technology Standards of the IEEE [http://ltsc.ieee.org] usually define a learning object as an integrated set of subject material together with its supporting services. Our approach is to have a lower level of granularity.

For example, it should be possible to use the same problem context in different learning activities. This agrees with some other designers of systems based on learning objects. Fisher (2001) suggests the need to define object classes and metadata to describe their combination. Koper (2000) on the other hand defines units of study composed of subject and learning models.

Learning objects have in this traditional sense have been applied to materials dealing with subject matter mainly out of context and addressed to educational rather than business needs. Our framework uses the ideas of learning objects but in a more fragmented way as illustrated in Figure 2.

Here early systems provided learning objects that can be simply implemented as electronic workspaces. It is suitable for

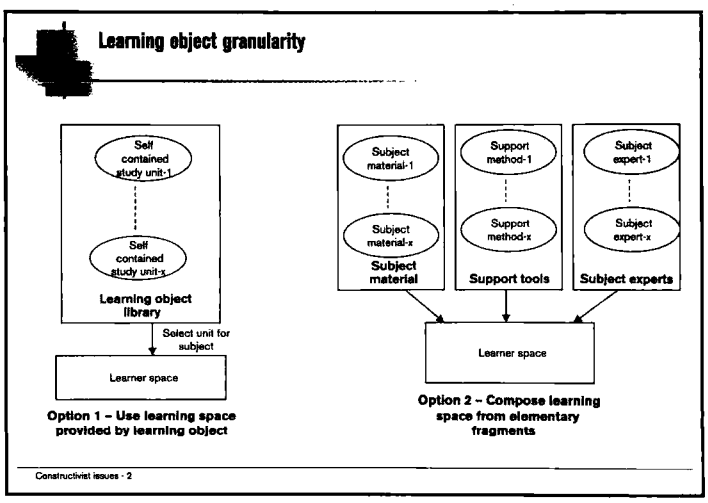


Figure 2 – Strategies for learning objects

environments solely concerned with teaching but is not appropriate to business practice for a number of reasons. First of all the subject material is often business specific rather than general. Secondly, it must be integrated into work spaces. An alternate approach is shown as option 2 in Figure 2. This is to have a more fragmented model of learning objects. One component is learning materials, another is various support services and finally subject matter experts. In the business environment the subject matter can be business specific whereas the support services can be general. Experts can then be matched to the material being used.

In a business environment the objects can include specific business documents rather than educational materials to provide the learning context.

An electronic learning space can then be composed from a number of such objects. What we now need is a framework for composing such workspaces.

2.2 A generic framework

The paper now proposes a framework for composing flexible learning processes. The framework provides a taxonomy, or grammar, for describing leaning processes. The main elements, or learning process concepts, of such a grammar for the learning process are shown in Figure 3. These include:

- Learning environment, or where learning takes place. This may be a university or a person's place of work. It may be within a business process,
- Learning goal, which describes what the process participant must learn,
- Learning plan, which defines the sequence of learning activities to be followed to achieve the learning goal,
- Learning activity, which describes a step of the learning plan; this may be create a report, evaluate a problem. Many such activities will in fact be engagements with other process components, in particular, process documents or process team members,
- Subject metadata, which provides explicit references to information needed in the activity,
- The learning method, which will be used in the learning step, and
- Support services provided for the learning method.

The general semantic here is that a learner specifies a learning goal. A plan, which is made up of a number of learning activities, is then constructed by the learner with assistance from an agent. Each activity has a learning subgoal and specifies the preferred learning method to be used by the learner. Wang (2005) defines a similar set made up of units (corresponding to our learning plans), activities (corresponding to our learning activities), and facilities (corresponding to our methods).

The conceptual framework can be used to identify some differences in learning in university and business environments. In university environments the learning goals are usually fairly broad and require plans composed of many activities. There are often fewer goals, for example, four goals corresponding to taking four subjects in a semester. In most business processes the learning goals would be of shorter duration but would occur more frequently and irregularly as new business issues arise.

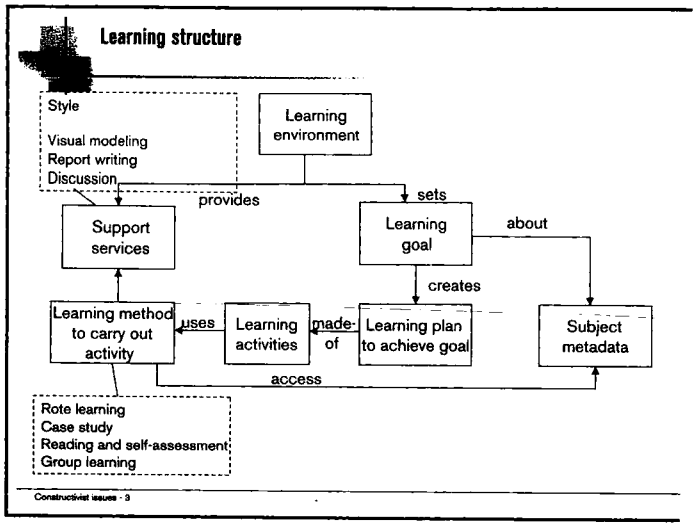


Figure 3 – A Framework for composing learning environments

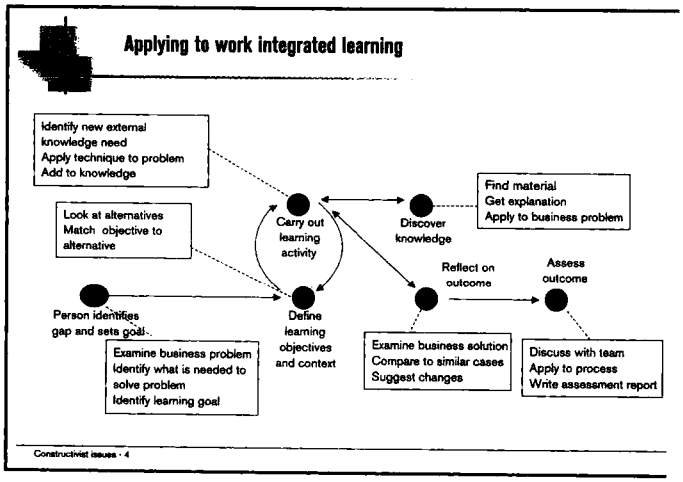


Figure 4 – Learning activity process

2.3 Defining processes

Our central aspect to learning is the activity. It can take place anywhere and use methods and support services relevant to the learning environment. Figure 4 shows an outline of how learning activities fit into a process made up of the elements shown in Figure 3. The black dots are the process steps, whereas the rectangular boxes show what happens in each process step

In summary:

- The first step is where the person or process participant examines their problem and identifies the knowledge gap and corresponding learning gap. This can be done either individually or through discussion with others,
- Then following an examination of learning resources an objective is set,
- A set of learning activities are then chosen,
- The learning methods are then chosen,
- Selected activities are then carried out, and

■ Finally the solution is examined and if agreed to applied to the business process.

3 Integration into business process

One goal of integration into business processes is that access to the learning resources should be integrated within the workspace of the business activity. Once a knowledge gap is identified, the system should present the learner with a workspace that addresses this gap. Our second goal is to reduce the effort required by the process participant to reduce their knowledge gap. Our proposal is to use software agents for this purpose.

An agent will assist the learner to set up and manage the activities. The agent uses the learner profile to select the necessary learning activities to address learner knowledge gaps. It can also use the learner's preferred learning style to select the best learning method. The activity results in the creation of activity records, which can be artifacts that must be produced as part of the activity. It also includes an evaluation step. The plan can of course be changed to do some additional catch up work if indicated during the evaluation.

3.1 Managing the learning plan using process agents

The goal is not to define specific agents for each learning need but to have a set of generic agents that can be put together to support any learning process. Thus there will be a generic agent to support any learning activity, a generic agent to support a learning plan, and so on. This theoretical approach is based on a metamodel of collaboration defined in earlier work, which identified the concepts to describe collaborative processes.

These included roles, groups, work-items, work-activities among others (Hawryszkiewycz, 2005b). The collaborative metamodel concepts identify candidates for generic agents (Hawryszkiewycz and Lin, 2003) and typical multi-agent architectures. Typical agents here include a role agent, a group agent, a work-item agent or an activity agent.

Based on such conversions, the following generic agents have been identified (Hawryszkiewycz, 2005a) to assist in managing the learning process:

■ An activity agent, which manages a learning plan,

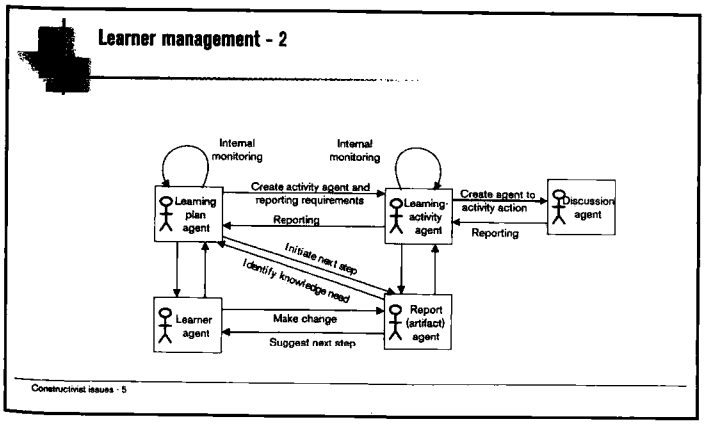


Figure 5 – Multi-agent structure for learner support

■ Work-item agents, each of which manage one learning activity,

■ Work-item agents, each of which manage one learning method,

■ An artifact agent, which manages an artifact that may be produced as part of learning and which serves as a check-list for building knowledge, and

■ A personal agent that supports the learner.

The way that agents interact with each other in a multi-agent architecture is shown in Figure 5 as follows:

■ The learning plan agent delegates work to learning activities by creating a workspace for the learning activity and its agent,

■ The learning plan agent monitors progress on the learning activity task,

■ The artifact agent serves as the collection of knowledge developed by the learner. It interacts with the learning plan agent to identify knowledge needs. The learning plan agent then sets up a learning activity to acquire this knowledge,

■ The learning activity agent can interact with the learner agent to find the learner's background when choosing the next learning activity, and

■ The learning activity agent can initiate any support activity such as situation assessment as needed.

We use the usual reasoning model of agents where an agent goal leads to a plan, which is defined in terms of rules that lead to actions. The plan itself can have lower level goals. The reasoning model is implemented using the three layer architecture (Müller, 1996) chosen from a number of alternative architectures (Wooldridge, 1999). Agents are used to achieve goals using plans defined by agent users. A plan is composed of event-condition-action rules, each of which specifies the actions to be executed when condition is true. We can predefine the goal, belief, plan, rule, and action for an agent or define them at run time.

3.2 Learning plan agent – creating learning activities

The learning plan agent would include the rules of actions to take when progress is not as expected. These would include:

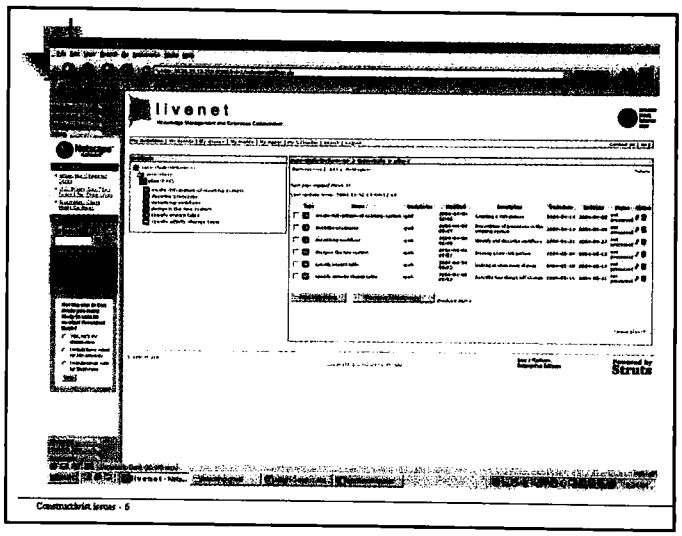


Figure 6 – The learning plan

Goal: Complete the learning plan;
Plan: for completing learning plan.
Subgoal g1: determine if next activity is to be started;
Subgoal g2: determine if additional learning activity is needed;
Subplan: for identifying additional activity
Rule: if next artifact step needs 'a' and learner has no 'a' knowledge then action start activity to learn 'a';
Subgoal g3: determine if expert advice is needed;

3.3 Creating the learning activity plan

As an example, this paper illustrates the application to team learning, which was described earlier (Hawryszkiewycz, 2005). Figure 6 shows an example of a learning plan for integrating knowledge management into e-business applications. It is composed of a number of activities that start with developing a model of a system, describing existing processes and then creating a new design. It shows the steps of the plan and their particular start and finish times.

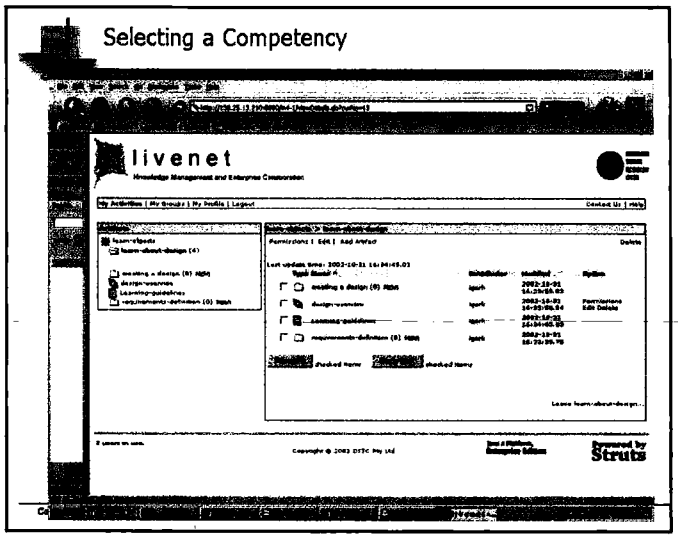


Figure 7 – A workspace for a learning activity

4 Creating workspace for learning activities

The learning activity agent uses the plan to create workspaces for each learning activity and monitor its progress. Figure 7 is an example of a workspace for a learning activity. It includes the background materials needed in the step, learning guidelines and the outcomes to be produced. It also contains examples of earlier solutions as well as templates and guidelines that can be used in the learning activity.

4.1 Transition to work processes

The final part of the paper considers ways of integrating the framework into business processes. The two issues are ways to initiate the activities, and ways to integrate organizational artefacts into the learning process.

The first of these is relatively straightforward. This is simply to include a link to the learning systems from selected screens in the work process. The learner can then initiate learning almost like a help button that says I want to 'find out how to do something' rather than 'find something'. Once this is selected the kind of process illustrated in Figure 4 can be initiated, providing workspaces with content similar to that shown in Figures 6 and 7.

To meet the second requirements the agent system will need to match the learning goal to instructional material and internal business documents. For example, suppose a new person is not familiar with the marketing strategy for a client. The agent can then bring together clients, marketing strategy documents, past examples of application, and links to experts in this area and make them available through an interface. It can also provide a general service such as a general discussion system that addresses marketing issues that can be consulted in the first instance prior to referring questions to busy experts.

In that case the activity can be classed as gaining familiarity with a process. A more structured approach is then to have a subsequent activity where the person actually defines a client strategy but needs to check it with experts prior to submission to a client. In that case the workspace would now also include a document that is accompanied by a check-list that must be followed thus further adding to the learning process. Comments can be made by experts on different points of the check list. This again is similar to constructivist learning where teachers act as guides rather than instructors.

5 Summary

The paper defined a framework that can be used to create customized learning environments. The framework centers on learning activities that can be composed to meet different learning needs. The paper then described ways of integrating this framework into business processes.

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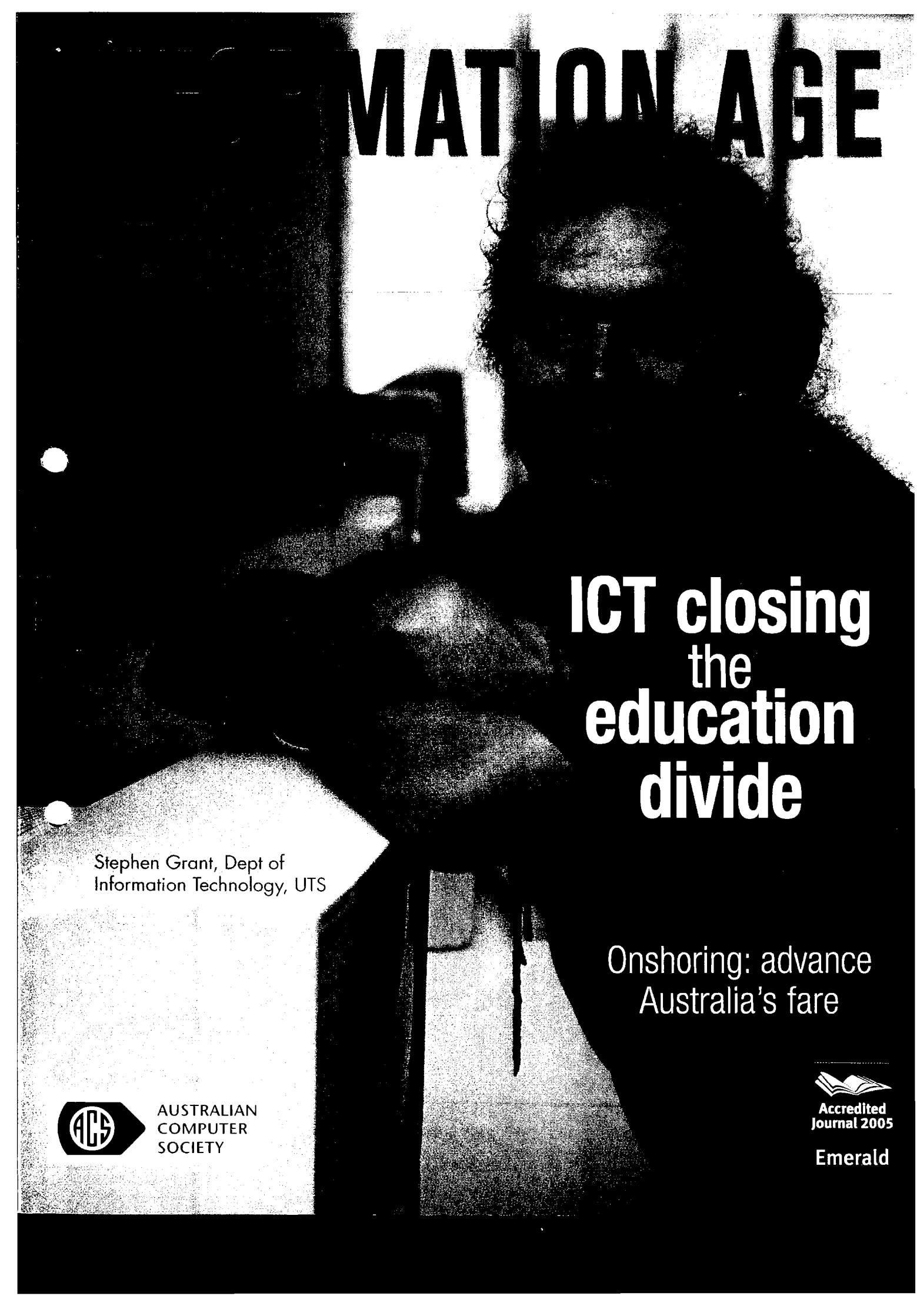

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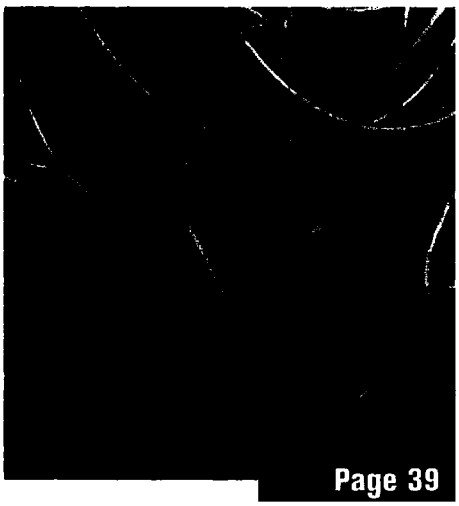

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