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Flexible Learning in a Digital World [1]

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ABSTRACT *This article and the book around which it based [Collis & Moonen (2001)* Flexible Learning in a Digital World: experiences and expectations *(London, Kogan Page)] is about changes in learning, teaching, the support and enterprise of education, and the role of technology in those changes. It considers these changes in a broad and integrated way using flexible learning as the integrating concept.*

Introduction

Flexible learning is a complex phenomenon even when expressed in terms of only four key components: technology, pedagogy, implementation and institution. We can visualize the relationship among the four components via the diagram in Fig. 1. (The size of the various shapes indicates in a general way their complexity and the number of actors involved. The nesting of the shapes indicates their interrelationships.)

Although fresh waves of factors are accompanying changes related to flexible learning, not the least the fact that the Internet and World Wide Web technology have become pervasive tools in the normal communication and information-handling strategies of people throughout the world, there is still much to be learned from

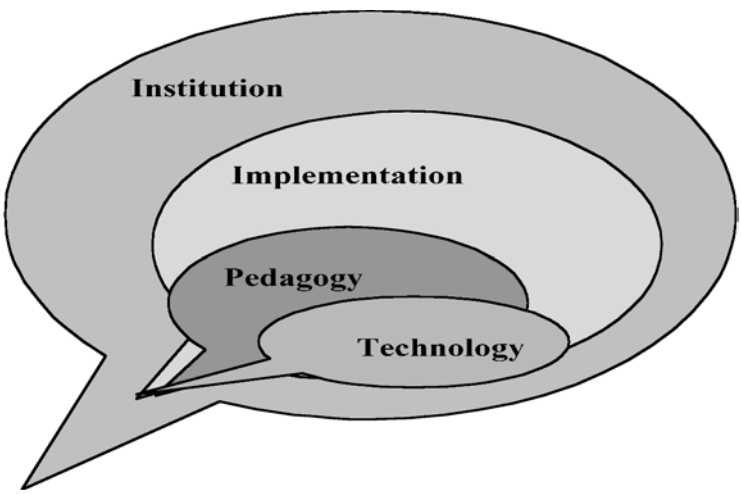

FIG. 1. Four key components of flexible learning.

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the last several decades of experience with technology and learning-related change. Thus the second major function of this article and the related book is to ground current and emerging experiences in a series of 18 major lessons learned from previous cycles of educational change and technology potential. The lessons are presented not in the style of results of a literature review, but in the style of practical guidelines. The purpose of the lessons is to crystalize past experience and make it useful in the present and future. Each lesson can be supported by considerable research as well as experience (see the website that accompanies the book, at <http://education1.edte.utwente.nl/00FlexibleLearning.nsf/frameform?readform>). We will discuss several of the lessons in this article and list them in Table I.

Although the book is based in a higher-education (post-secondary) context, the lessons and the issues discussed are also applicable to other sectors. The institutional perspective involves many issues also confronting schools and training settings. The implementation problems we discuss are also common in schools and training institutions. The technology perspective is relevant to all. Also, we do not restrict our view of flexible learning or our use of technology to 'distance education', as we discuss in the next section, but apply it to any type of learning setting, including traditional face-to-face meetings.

What Is Flexible Learning?

Flexible learning is becoming somewhat of a buzzword: everyone is for it, but often people have not thought further about it, except perhaps that it means something about distance education. This relates to the first of our lessons learned: that such vagueness is not desirable and even counterproductive. To put the lesson into practice we have to realize that flexible learning can involve many dimensions, only one of which is related to location of participation. While flexible learning offers many opportunities, we also should recognize that trying to implement flexible learning brings with it many problems and challenges. These problems and challenges relate to the four key components of flexible learning—technology, pedagogy, implementation strategies, and institutional framework—visualized in Fig. 1.

Flexibility Dimensions: more than distance

To begin, what is flexible learning? Flexible learning is often taken as synonymous with distance education. This is not necessarily so. There are many ways to make education more flexible that can benefit students who are in full-time residence on a campus and even benefit those who are in the same room together. Flexibility can involve options in course resources, in types of learning activities, in media to support learning, and many other possibilities. There is more than distance that can vary.

We will use the term *flexible learning* in a broad way, with the key idea being *learner choice* in different aspects of the learning experience. Flexible learning is a movement away from a situation in which key decisions about learning dimensions are made in advance by the instructor or institution, toward a situation where the learner has a

TABLE I. The lessons learned

Lesson 1. *Be specific*	We need to define our terms and express our goals in a measurable form or else progress will be difficult to steer or success difficult to claim.
Lesson 2. *Move from student to professional*	Learning in higher education is not only a knowledge-acquisition process but also a process of initiation into a professional community. Pedagogy should reflect both acquisition and contribution-oriented models.
Lesson 3. *You can't not do it*	The idea whose time has come is irresistible, and conversely:
Lesson 4. *Don't forget the road map*	Change takes a long time and is an iterative process, evolving in ways that are often not anticipated.
Lesson 5. *Watch the 4-Es*	An individual's likelihood of voluntarily making use of a particular type of technology for a learning-related purpose is a function of four 'E's: the environmental context, the individual's perception of educational effectiveness and of ease of use, and the individual's sense of personal engagement with the technology. The environmental context and the level of personal engagement are most important
Lesson 6. *Follow the leader*	Key persons are critical.
Lesson 7. *Be just-in-time*	Staff-engagement activities to stimulate instructors to make use of technology are generally not very effective: focus on just-in-time support for necessary tasks.
Lesson 8. *Get out of the niche* any technology product.	Most technology products are not used in practice beyond their developers. Keep implementation and the four Es central in choosing
Lesson 9. *After the core, choose more*	Technology selection involves a core and complementary technologies. The core is usually determined by history and circumstances; changing it usually requires pervasive contextual pressure. The individual instructor can make choices about complementary technologies and should choose them with flexibility in mind.
Lesson 10. *Don't over load*	More is not necessarily better.
Lesson 11. *Offer something for everyone*	A well-designed WWW-based system should offer users a large variety of possibilities to support flexible and contribution-oriented learning not dominated by any one background orientation. If so, it is currently the most appropriate (core or complementary) technology for flexible learning.
Lesson 12. *Watch the speed limit*	Don't try to change too much at the same time. Start where the instructor is at, and introduce flexibility via extending contact sessions to include before, during and after aspects, with each of these made more flexible. Move gradually into contribution-oriented activities.
Lesson 13. *Process yields product*	Through the process of contributive learning activities, learners themselves help produce the learning materials for the course.
Lesson 14. *Aim for activity*	The key roles of the instructor are becoming those of activity planning, monitoring, and quality control.
Lesson 15. *Design for activity*	Instructional design should concentrate more on activities and processes, and less on content transmission and a pre-determined product.

TABLE I. The lessons learned—*continued*

Lesson 16. *Get a new measuring stick*	What we are most interested in regarding learning as a consequence of using technology often can't be measured in the short term or without different approach to measurement. Measure what can be measured, such as short-term gains in efficiency or increases in flexibility.
Lesson 17. *Be aware of the price tag*	It is not going to save time or money to use technology, at least not in the short term.
Lesson 18. *Play the odds*	A simplified approach to predicting return on investment (ROI) that looks at the perceived amount of relative change in the factors that matter most to different actors is a useful approach to support decision making or evaluation.

range of options from which to choose with respect to these key dimensions. Figure 2 shows some of these key dimensions.

Figure 2 is not an exhaustive list. Distance relates only to Item 15. Clearly there is much more that can be involved in moving from fixed, or less flexible, to more flexible learning. How can this work in practice? We need to move from abstractions to options.

Flexibility in Practice

No flexibility option is simple to carry out in practice. Figure 2 shows that flexible learning is not a simple goal, nor does it necessarily mean only distance flexibility. Also, within each flexibility dimension, there are many possible options. Even within traditional distance education, for example, many variations exist that can limit flexibility related to distance, and students may not be offered an option about participating. Learners may be occasionally required to attend residential sessions on specific days or go to local study or participate, via technologies, at a preset time in distributed group discussions or sessions. All of these requirements impinge on the learner's freedom in choosing where she will learn. From challenges such as these, and others, Table II summarizes some of the major barriers confronting the desire to make learning more flexible.

If an institution wishes to commit itself to flexible learning, it needs to make explicit choices as to which flexibility dimensions it will focus upon, and what range of options will be feasible to offer within these dimensions. Dimensions being frequently chosen by traditional institutions currently include (Collis, 1998):

- Improving *flexibility in location* of where the learner can carry out different learning activities associated with a course.
- Improving *flexibility in programme*. Assuming the learner has relevant previous experience, subgroups of courses can be chosen in terms of the learner's needs and interests.
- Improving *flexibility in types of interactions* within a course, so that, for example, students who benefit from group interaction and group-based project work can

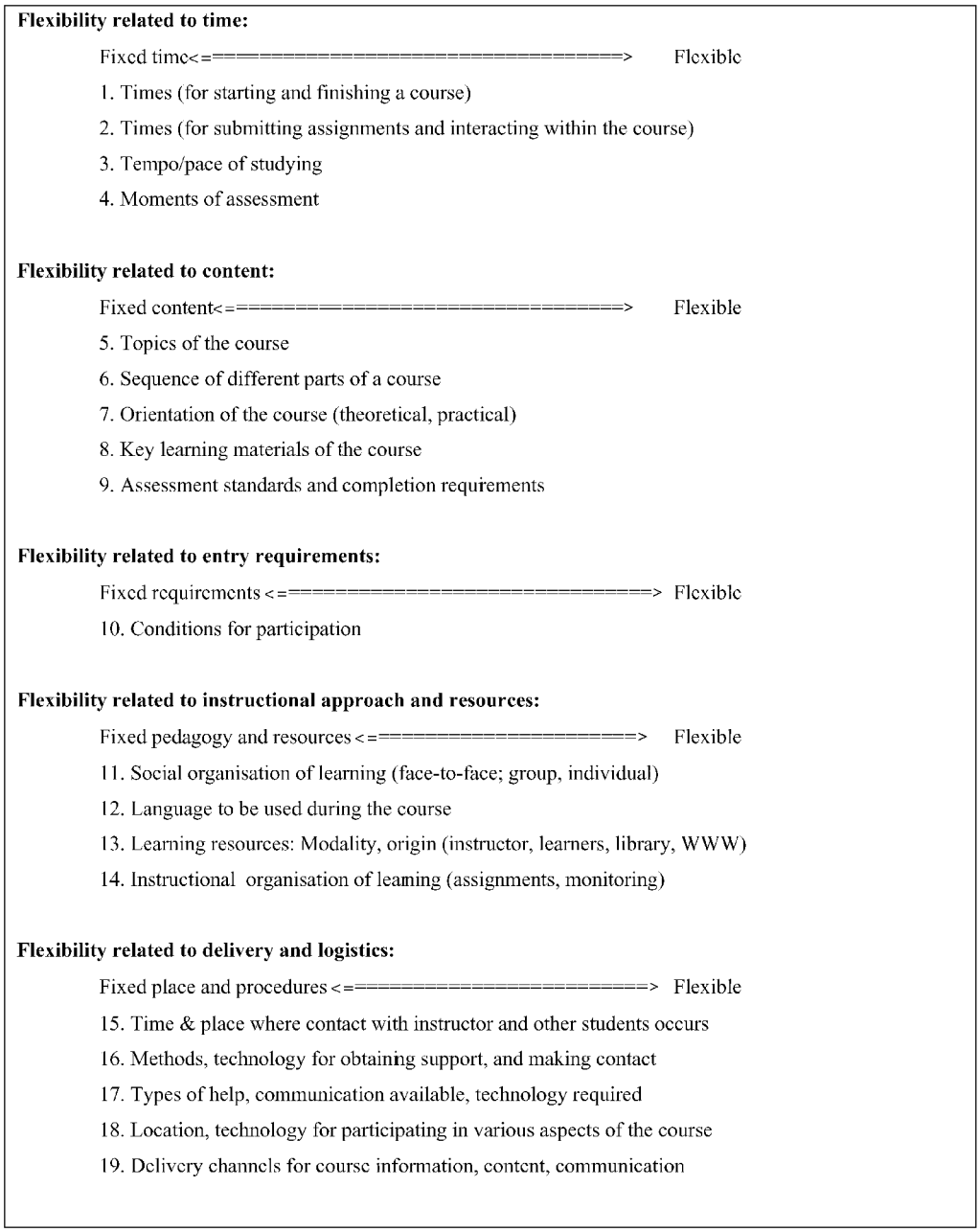

FIG. 2. Dimensions of learning flexibility, options available to the learner (revised from Collis *et al.*, 1997).

choose for these sorts of opportunities, while other students, perhaps with families and work commitments who benefit more from the freedom to organize their own times and ways of studying, can also be accommodated within the same course.

- Improving *flexibility in forms of communication* within a course, so that learners and

TABLE II. Factors constraining learning flexibility

Key constraints on flexibility	Key actors related to the constraints
Flexibility is unmanageable …	Instructors cannot handle what can amounts to individualized instruction because of time and also cognitive constraints if the number of learners increases.
	Instructors do not have the time or resources to anticipate the permutations of options that a learner may choose and produce cohesive, good-quality variations of courses available to reflect those options.
Flexibility is not acceptable …	The legitimizing agency related to a course cannot handle a wide variety of course permutations in terms of recognition for the course.
	The culture of which the learner is a part is not oriented toward the idea of learner choice, but instead expects the course provider to be responsible for pre-specified decisions about the course offering.
Flexibility is not affordable …	Each combination of options may require some *re-engineering* of the course; economy of scale is not likely to occur.
	Personnel and technical implications of many learner choices are much more costly than any course provider could support.
Learning flexibility is not realistic …	Learner flexibility may require an imaginative and creative approach to course re-design that is outside the scope of many instructors (relatively few persons are innovators).
	Some combinations of options are not compatible with each other by their very nature (if a learner prefers to work at an individual pace, choosing his own content and sequence of content, he cannot expect to also be having real-time interactivity via video-conferencing with classmates; if a learner chooses to work in her own language and it is a language that others in her course do not speak, she cannot insist on a stress on human–human interactivity, either real-time or asynchronous).

instructors have a wider variety of ways for more targeted and responsive communication than is the case when communication is limited to what occurs during face-to-face sessions such as lectures, or incidentally in the hallways.

- Improving *flexibility in study materials*, so that the students not only have a wider choice of resources and modalities of study materials from which to choose than only what the instructor has previously selected for them, but also come to share in the responsibility of identifying appropriate additional resources for the course and even contributing to the learning resources in a course.

Thus an important first step in a move toward more flexible learning is to take the time to develop consensus within the institution as to what is meant by this term. Flexible learning needs to be made operational, expressed in terms that can be turned into manageable options to offer to students.

While it seems sensible to take this sort of care in terms of moving from a goal stated in general terms (flexible learning) to goals stated in specific and operational

terms, it has been our experience that this is often not done, particularly in change initiations involving technology. A typical phenomenon with earlier waves of interest in computer-related learning has been the statement of abstract goals ('revolutionize education', 'individualize learning', or even 'increase economic competitiveness') expressed in vague and non-concrete terms. One of the consequences of such vagueness is a subsequent lack of evidence of success. Another consequence is that decision makers move on after the vague statement of goals and leave it to the subsequent implementation manager to make the vision concrete. This may not turn out to fit the unspoken ideas of the original decision makers, leading to problems with institutional support and funding. All of this relates to the first of our lessons learned (see Table I).

But the situation is not static, nor should we sound overly pessimistic; there are ways to offer at least some aspects of flexible learning within human, organizational, and societal constraints. In our book, we elaborate strategies based on four components shown in Fig. 1 and their interrelationships. We also present an extended case study of our own institution to illustrate the strategies and application of the lessons in practice. In the remainder of this article, we highlight some of the major concepts underlying these strategies.

Components of Flexible Learning in Higher Education

In Fig. 1, we expressed flexibility in terms of four main components necessary to make it possible in practice. These components are: technology, pedagogy, implementation strategy, and institutional framework. These components individually form the focus of Chapters 2–5 in the book. Their integration forms the focus of Chapter 6, return on investment, and Chapter 9, future scenarios, as well as the extended case study in Chapters 7 and 8. We introduce key concepts relating to the components here.

Technology

When we speak of *technology* we are generally referring to the combination of information and communication technologies. Information technologies involve computers; communication technologies will be taken as involving network systems, and in particular data networks running under the Internet protocol (IP). Because network connectivity is becoming standard for computers in higher-education institutions, the use of the term technology generally refers to some aspect of computers connected to an IP network. Computers and networks do nothing without software tools and applications; thus the term *technology applications* is used to refer to the various categories of software that can be typically used for the learning-support process in higher education. When we speak of a particular example of a type of technology application, such as a particular WWW site or a particular computer-conferencing system, then we will call that particular example a *technology product.* Main types of technology applications related to flexible learning include e-mail and other communication tools, groupware tools, computer-based tutorials, test systems

and simulations, web-based information collections and tools for handling information, and integrating all of these, web-based course-management and learning-management systems.

A major concept relating to technology is that of core and complementary technologies. By core technologies, we mean the major artefacts around which a learning experience is planned and carried out: if these technologies are not available, there is a serious problem is going forward. In traditional higher-education institutions, the core technologies are the textbook and the lecture (or other form of face-to-face contact session). Within disciplines, the core technologies differ. In a chemistry course, the core technologies may be textbooks and the laboratory. In traditional open and distance education, the core technology is either print material and/or television/video-conferenced contact sessions. In what many companies are now calling e-learning, the core technology is a web system. The core technology for a course in a higher-education institution is often pre-determined by the operational procedures of the institution, as well as the culture of the discipline.

In contrast, complementary technologies are used to extend or enrich the core technologies. Handouts, videotapes, PowerPoint slides, websites, extra readings, field trips: all can be valuable, but can also be expendable if necessary. Complementary technologies are much more related to the ideas of the individual instructor rather than institutional procedures. In general, we observe that change in technologies is best begun by gaining experience with new forms of complementary technologies to extend core technologies or make them available in more flexible ways before the time is right for an institutional decision to change a core technology. Flexibility can be increased via strategic changes in complementary technologies while retaining established core technologies.

The lessons developed relating to technology are Lessons 8–11 as given in Table I.

Pedagogy

Pedagogy is defined (at least in some countries) as '*the art and science of teaching* ... the knowledge and skills that practitioners of the profession of teaching employ in performing their duties of facilitating desired learnings in others' (Dunkin, 1987, p. 319). Although there are other terms that could be used, for example, *didactics* or *instructional approach*, we will use the term *pedagogy* here to indicate the manner in which the teaching and learning processes and settings in a course is organized and implemented by an instructor. Teaching in higher education most generally takes place in a course context with an individual faculty member responsible for an entire course, but many variations occur. For convenience and because it is the majority situation in traditional higher-education institutions, we focus on pedagogy within the course context, and use the term instructor in the singular. We focus particularly on two key pedagogic models that can motivate different developments in flexible learning, and a framework that integrates the models with more or less flexibility to identify four key quadrants relating to instructional change.

Pedagogical Models. A pedagogical *model* relates to the abstract concepts about the learning and teaching process that underlie the approach. Sfard (1998), for example, identifies two basic types of educational models, the *Acquisition Model* and the *Participation Model*. With the Acquisition Model, the focus of learning activities is on the acquisition of pre-specified knowledge and the development of pre-determined concepts. With the Participation Model, the focus of learning activities is on becoming a member of a community of practice, learning from the community but also contributing to it. With the Acquisition Model, what is to be learned is generally pre-determined. Frequently the extent to which the learner has learned is measured by a written test. Often there are pre-determined right answers. In contrast, with the Participation Model, the interactions that the learner contributes to may serve to change the knowledge base of the community even as he participates. There are not right answers, but rather degrees of insight, belonging and participating. Sfard emphasizes that both models are needed in higher education.

We believe however that participation is not enough: the participant must also *contribute* to the learning experience. Acquisition and participation are not new ideas, but contribution is less discussed.

Because activities are the instructional experiences that learners participate in beyond getting input through reading or listening (Brophy & Alleman, 1991), we speak of educational models with activity goals related primarily to acquisition or primarily to participation and contribution, and argue that a movement toward the latter in higher education is desirable. Because contribution cannot occur without participation (although the converse is not necessarily so) we will refer in particular to a distinction between an acquisition model and a contribution-oriented model. Ways in which a contribution approach can be realized include:

1. searching for additional information or examples and making these available for others;
2. working with a case as a basis for problem solving and contributing some additional materials for the case for use by others;
3. participating in a role-play situation and leaving some record of the results of the role-play for others to consider;
4. creating a report to then be used as a learning resource by others;
5. creating a product, such as a multimedia resource or a design, that is also a resource for others;
6. extending and applying theoretical principles in new settings and adding these results to a course repository of extension materials;
7. testing one's insight through the development of test questions to be used by others; and
8. participating in a discussion and leaving a record of key aspects of the discussion for use by others.

In each case, the web environment is used as the workplace for working on, contributing, and subsequently accessing the contributions. The 'others' in the above list of activities types may be other students in the same course or within a student's group in the course. But they may also be other students in other cycles

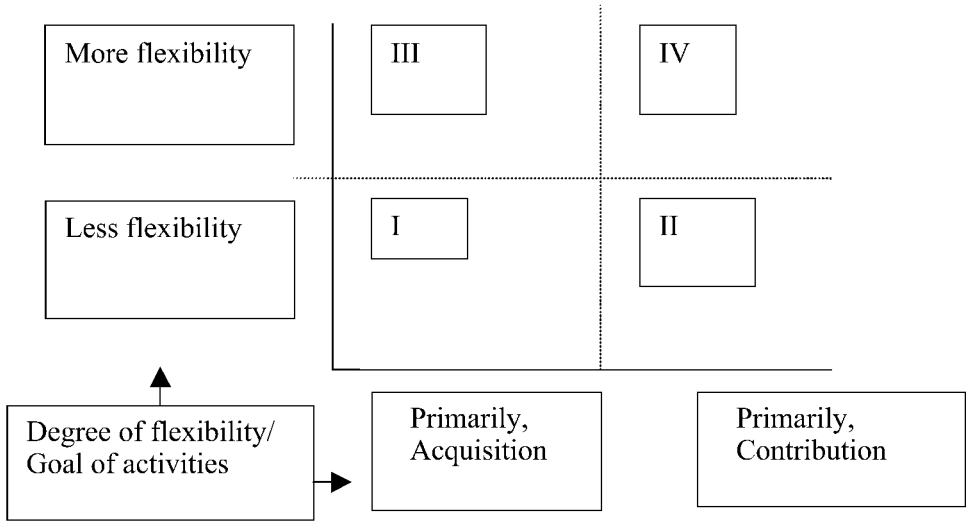

FIG. 3. The Flexibility–Activity Framework

of the course or students in other courses or learners who are not in a course context at all but could refer to the materials via a database rather as they now use a library. The idea of re-use of students' work and of moments of good communication in a course supports flexibility: for those who were not present when a moment of good communication occurred, for example, or to facilitate the development of a substantial database of learning resources that can be re-used and combined in many different combinations.

The educational models relating to activity goals are fundamental to our discussions of pedagogy and change in higher education. They relate to Lessons 2, 13, 14, and 15 (see Table I).

The Flexibility–Activity Framework

By using the activity-goal dimension, we have a way to relate pedagogy to flexible learning. By combining an educational-model dimension with activity goals focused on acquisition or contribution with a flexibility dimension with categories relating to less and more flexibility, we can define a *Flexibility–Activity Framework* as shown in Fig. 3. This framework is used throughout the book.

Extending Sfard's analysis to include a movement toward more flexibility as well as toward more contribution, we believe that courses in higher education should become identified with Quadrants III and IV, with a tendency toward Quadrant IV. We believe they are now predominately in Quadrant I.

Implementation Strategies

Next to technology and pedagogy, the third component of flexible learning relates to its *implementation* in practice. A pedagogical theory means little if instructors do not

apply it and technological resources have no value if not used. A fact that has long been seen with computer-related products is that they are not used by the majority of instructors. Implementation is a critical component of a move toward more flexible learning in an institution, because without implementation efforts stimulated at the institutional level it is likely that only pioneers will move forward. The number of instructors who choose to be innovators with technology and pedagogy is limited. An implementation strategy, with incentives, a methodology for gaining instructor involvement, and an effective manager are necessary.

Factors that influence the implementation of a technology innovation in an educational setting have been well studied. We see these factors as having a relationship with each other that we describe by the *4-E Model* (Collis *et al.*, 2001). This model says that an individual's likelihood of making use of a technological innovation for a learning-related purpose is a function of four groups of factors: *environment* (the institutional context), *educational effectiveness* (perceived or expected), *ease of use*, and *engagement* (the person's personal response to technology and to change), each expressed as a vector. In the 4-E Model, the environmental factor determines the level of the success threshold; a stronger environmental climate pushes the threshold lower so that the vector sum of the other three vectors does not have to be as high as when the threshold is associated with a weaker environmental vector. Figure 4 shows a 4-E Model profile of an individual with a weak *ease of use* vector, a weak *engagement* vector, and a moderately positive *educational effectiveness* vector. His vector sum is (almost) high enough in Environment Condition #1 to probably make use of a telematics innovation in his teaching. In Environmental Condition #2, the push from the environmental vector is too weak and thus the threshold is too far away; he is not likely to make use of the innovation.

The 4-E Model shows how educational effectiveness, ease of use, personal engagement, and environment factors are interrelated in predicting an individual's likelihood of use of a telematics application for a learning-related purpose (Collis *et al.*, 2001).

We use the 4-E Model as an intuitive guide to predicting implementation success and shaping implementation strategies. Lessons 4–7 (see Table I) relate to implementation.

Institutional Framework

The manner in which pedagogy is carried out in a course and technology is used is influenced by many factors outside of the particular course itself. Courses are offered as part of a programme by an educational institution, and therefore must relate to that programme in terms of content and expectations for the students. Also courses must occur within the operational processes of the institution, in terms of length, time-related aspects, admission criteria, examination procedures, and also in terms of the resources available to the students for carrying out course requirements. Thus the pedagogical decisions of the instructor are constrained by many factors outside

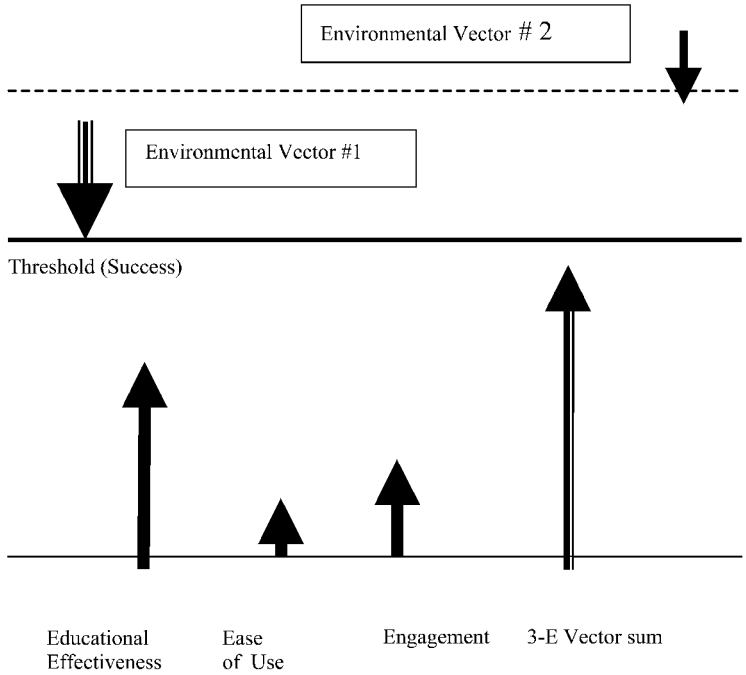

FIG. 4. The 4-E Model.

the instructor's control. They are part of the institutional framework affecting flexible learning.

Institutions also differ in the amount of support that is offered to the instructor relative to his teaching. This support can include direct support during the course itself, in terms of persons available to assist the instructor in some of the course-execution tasks; can relate to support during the preparation of the course; and can be offered more generally, in terms of helping instructors gain new skills and insights relating to their pedagogical practices. Support also relates to the library services and technological infrastructure available to the instructor for use in the teaching process. These are also part of the institutional framework.

There are other institutional aspects as well, some of which are more difficult to quantify. The social and professional climate in an institution, the management style of its leaders, the institution's previous experiences with technology-related change, and the vision of the leaders and of key persons with an influence in the institution all affect the movement toward flexible learning. In the 4-E Model, we visualized the importance of the institutional context on implementation success. A key observation related to decision making at the institutional level is that expressed in Lesson 3 (see Table I). The timing of change is often related to the perception that 'You can't not do it'.

Conclusion

Given all the complexities, why continue? Who is it that wants flexible learning? The answer in general is: educational institutions and their competitors, technology specialists and students.

The changing characteristics of students in post-secondary education is one of the most important arguments for flexible learning. Students in the normal intake routes, directly from secondary school and resident at or nearby the physical campus, are being joined by increasingly diverse cohorts. These cohorts are diverse in age, educational backgrounds, experiences, distances in which they live from the campus, and even cultures and native languages (Langlois, 1997). These diversifying demographics are in turn a reflection of the need in society for *lifelong learning*, particularly in the international context of increasing career mobility (Krempl, 1997). This need has at least the following aspects:

- Students will increasingly require educational programmes and a way of experiencing those programmes tailored to their own situations, rather than fitting a standard model, especially when this standard model is based on a young, professionally inexperienced, full-time student, living on the campus and needing a full range of courses for a certain degree.
- For some learners, there would be less time needed and lower expenditures for a particular learning event if the event could be experienced as a module instead of the learner having to participate in an entire course and if that the learner could participate in the event in a time period and location convenient to that person.
- For the working person, better quality of results could be potentially achieved, in that only the necessary content, in the most up-to-date versions of resources, would be chosen.
- Theories and experience with adult education show such education to be effective to the extent that it is relevant to the adult learner, closely related to her own learning history, has transfer value to her work, and is efficient in terms of demands on her time and energy.

All of these require individualization of learning experiences, and thus call for increased flexibility in learning alternatives. If higher-education institutions do not respond to this changing demand from students, other service providers will. In Chapter 9 of the book we offer for profiles for the future of higher education, related to flexibility.

Thus, we have identified flexible learning as a complex domain and one that could be experienced in many different ways. We have also seen some of the opportunities as well as constraints that will confront translating abstractions into practice. A major portion of this article has been the attempt to define the term *flexible learning* in a way that can be made concrete in terms of the institutional framework that will shape and steer it, implementation strategies that will make it happen, pedagogical approaches that will give it learning value, and technology that serves as its tool. The lessons we discussed relate particularly to two important aspects of this relationship:

the need to have a clear view of what is intended by flexible learning for a local context and the need for an underlying educational model for any change process involving technology.

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Note

[1] This article is a reworking of material from the introduction and Chapter 1 of Collis and Moonen (2001).

References

BROPHY, J. & ALLEMAN, J. (1991) Activities as instructional tools: a framework for analysis and evaluation, *Educational Researcher*, 20(4), pp. 9–24.

COLLIS, B. (1998) New didactics in university instruction: why and how, *Computers & Education*, 31(4), pp. 373–395.

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

COLLIS, B., VINGERHOETS, J. & MOONEN J. (1997) Flexibility as a key construct in European training: experiences from the TeleScopia Project, *British Journal of Educational Technology*, 28(3), pp. 199–218.

COLLIS, B., PETERS, O. & PALS, N. (2001) A model for predicting the educational use of information and communication technologies, *Instructional Science*, 29, pp. 95–125.

DUNKIN, M. J. (1987) Introduction to Section 4: classroom practices, in: M. J. DUNKIN (Ed.) *The International Encyclopedia of Teaching and Teacher Education* (Oxford, Pergamon Press).

KREMPL, S. (1997) The virtual university: education in the cross light between economy, politics, and society, in: J. HLAVICKA & K. KVETON (Eds) *Proceedings of Rufis '97: role of the university in the future information society* (Prague, UNESCO International Centre for Scientific Computing).

LANGLOIS, C. (1997) Information technologies and university teaching, learning and research, in: J. HLAVICKA & K. KVETON (Eds) *Proceedings of Rufis '97: role of the university in the future information society* (Prague, UNESCO International Centre for Scientific Computing).

SFARD, A. (1998) On two metaphors for learning and the dangers of choosing just one, *Educational Researcher*, 27(2), pp. 4–13.