Evaluating the flexibility of a pedagogical framework for e-learning.

Maia Dimitrova[1]
Mike Mimirinis[1]
Alan Murphy[1]*

[1] Middlesex University
* Alan Murphy now works within the Harrow Business School, University of Westminster.

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Maia Dimitrova, Mike Mimirinis, Alan Murphy
Middlesex University
{M.Dimitrova, M.Mimirinis, A.Murphy} @mdx.ac.uk

Abstract

Flexible pedagogical frameworks are needed to underpin e-Learning environments in order to ensure that they address effectively the individual learning approaches of an increasingly diverse student population. A quantitative study of the flexibility of one pedagogical framework for instructional design, called I CARE, identified its limitation in supporting two types of learners: those who rely extensively on social interaction and those most in need of learning support in the novel mode of learning. To support the learning processes of such students, they should be given a choice of learning activities and tasks that support the development of different cognitive skills and promote meaningful online communication.

1. Introduction

Information and communication technologies allow various ways of adapting e-Learning environments to individual learning approaches. The pedagogical frameworks that underpin these technologies need, therefore, to be flexible in order to effectively support the individual learning approaches of the increasingly diverse target learners. For educators to be able to identify which framework is best suited to their subject matter and learning context, the effectiveness of such frameworks needs to be tested with a diverse range of technologies and in different educational contexts.

A number of pedagogical frameworks have been developed, ranging from specific ones, such as role-based learning [6], to more generic ones, such as I CARE [4]. To be able to assess the *flexibility* of the e-Learning environments and their underlying pedagogical frameworks, a clear definition of what constitutes flexible learning is needed. Criteria for assessing their flexibility then need to be formulated.

Flexible learning can be defined as the extent to which the learning environment supports a range of individual learning approaches adopted by target learners. The underlying pedagogical framework, therefore, needs to be responsive to the needs of a diverse student population [3]. Students should be able to make personal choices regarding not only when and where to learn but also how to engage with the learning environment in a personally-relevant and stimulating ways that promote autonomous and self-directed learning [5]. E-Learning environments should also foster learner-learner and learner-tutor interaction and collaboration [1]. Finally, flexible learning environments should be designed to benefit low-ability students by allowing them a choice of learning tasks that suit their level of knowledge and ability.

This paper presents a quantitative evaluation of the I CARE pedagogical framework [4]. The main elements of the framework are first described, followed by a description of an e-Learning environment created for teaching Businesses Information Technology and Electronic Commerce, which was built according to I CARE. A set of criteria for measuring the flexibility of e-Learning pedagogical frameworks are then formulated and the method for evaluation explained. The results from the evaluation are then presented and discussed. The paper concludes with recommendations for enhancing the flexibility of the I CARE framework and its implementation in e-Learning environments.

2. I CARE

The I CARE pedagogical framework [4] was distilled from basic instructional design practice, adapting five steps of instruction: Introduction, Connect, Apply, Reflect and Extend. It explicitly recognises "learners' prerogative to organise their course time around work, family, and other commitments, while maintaining a modular structure of 'do-able chunks' arranged in a progressive series". Each chunk or unit is structured according to the five steps, which are described below:

- The *Introduction* serves to place each unit in the context of the course, and clearly states the objectives of the unit.
- The *Connect* section is primarily for presenting new information in context. It may consist of online text and graphical representations of subject matter content.
- The *Apply* section is the practice section, where newly acquired skills and knowledge is put into practice. It might involve writing a short paper, conducting a hands-on project or a group activity.
- The *Reflect* section gives students an opportunity to reflect on their newly acquired skills and knowledge. This might take the form of a thoughtful response to a carefully crafted question from the instructor, or a peer exchange about lessons learned.
- The *Extend* section can provide closure, prompt further exploration and learning, and assess students' skills and knowledge.

3. E-Learning Environment

An e-Learning environment was developed for teaching Business Information Technology and Electronic Commerce to postgraduate students in four countries: the UK, Egypt, China, and Singapore. A combination of complementary learning materials was developed, including a learning environment within WebCT and CD-ROMs in addition to traditional textbooks and lecture notes. The WebCT contains the core course materials, self-assessment tools and facilities for learner-instructor and learner-learner interaction. The CD-ROMs contain all the course material except for the activities which the students have to complete online, e.g. online assessment. All students use the same learning resources. The students in the UK follow the courses primarily in full-time classroom-based mode, where the face-to-face component is stronger. The students in Egypt, China, and Singapore, follow the course in part-time distance blended learning mode, with limited face-to-face interaction with local tutors and peers during weekly seminar sessions.

Each course has a modular structure, where the content of each module is divided into learning units. The learning units were implemented according to the I CARE framework. A departure from the original I CARE model is that the 'Connect' component was changed to 'Content', as it was assumed that 'Content' would have a more obvious meaning for students [7].

Figure 1 represents the five learning components and their connectivity in the e-Learning environment.

The *Introduction* section sets the learning objectives of the unit. The *Content* section presents a fairly linear development of the material in textual and graphical formats. At relevant places, hyperlinks to the *Apply* section offer the opportunity to move away from the narrative into activities with a wider, more exploratory scope. These may be computer-based, such as programming or design exercises, or paper-based, such as examining an exemplary case study, or web-based, such as visiting relevant web-sites. Hyperlinks to the *Reflect* section present questions designed to reprise recently-learned material in a reflective way. The hyperlinks between these sections enable a greater variety of learner-content interaction. The *Extend* section contains a review quiz to assist students in self-evaluation and to enable tutors in monitoring student progress. This section also contains additional material provided by the tutor to allow students who are more engaged to explore beyond the confines of the syllabus.
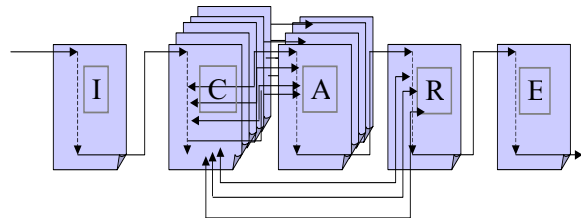

Figure 1: The implementation of the I CARE framework

4. Measuring Flexibility

4.1 Criteria for Measuring Flexibility

According to the 'Three by Three' model of flexible learning [5], shown in Figure 2, three types of processes can be made flexible: the administrative processes, the learning processes, and the assessment processes. The flexibility of these processes can be measured in terms of location, time and method.

In order to assess the flexibility of pedagogical framework, the extent to which it affords different methods to learning needs to be measured. This aspect is covered by the second type of processes on Figure 2 and method dimension along the horizontal axis.

The following four flexibility criteria are defined within this dimension:
- are students provided with a variety of learning tasks and activities, including individual and

group ones, that encourage the development of different cognitive skills;

- is a multiplicity of traversal paths allowed within the learning materials; and
- is a choice of asynchronous and synchronous communication tools provided to facilitate collaborative learning.

	Location	Time	Method
Administrative Processes			
Learning Processes			
Assessment Processes			

Figure 2: 'Three by Three' Model [5]

To measure the flexibility of students' learning with the e-Learning environment the students' learning behaviour with the technology and interaction styles with their peers and teachers were measured. Longitudinal studies were conducted over the past two consecutive academic years. A structured questionnaire was administered both in online and in paper formats to reach the maximum number of students. The study participants and the questionnaire are described below.

4.3 Participants

The number of participants varied across the different locations for each year of the study. For year 2002/03, questionnaires were collected from 69 of the classroom students resulting in a response rate of 46%. With regard to the distant students, 34 students completed the questionnaire, which represents a response rate of 23%. The distance students study part-time and have to balance other demanding obligations, such as family and full-time work in addition to their studies, which may have prevented some of them from completing the questionnaire and reduced the response rate. Nevertheless, special attention was paid to secure that the diversity of the students' population was reflected in the sample. For year 2003/4, 51 questionnaires were collected from the classroom students resulting in a response rate of 42%, and 23 questionnaires were collected from the distant students producing an increased response rate of 43%.

4.3 Learning Behaviour Questionnaire

The aim of this questionnaire was to identify how students make use of the learning materials and to generate usage patterns. In particular, it gathered data on students' preferred medium of study, the amount of time spent on each unit, and the frequency of browsing of different materials. Special emphasis was given to study the amount of effort students spend on each I CARE component. Information regarding participation in group discussions and use of online communication tools was also collected to identify different ways of social interactions and learner-learner and learner-tutor communication during face-to-face and online sessions.

This questionnaire consisted of twenty questions, most of which were multiple choice with a single answer but some questions were open to multiple answers, providing thus a wider spectrum of alternative answers.

Hierarchical cluster analysis was chosen as a suitable technique of identifying patterns in learners' behaviour and therefore, produces a meaningful categorisation of students and the way the learn with the technology. Descriptive statistics was used to determine the variables of greatest statistical importance and consequently variables with low standard deviation have been excluded from further analysis. The more important variables were the ones measuring the proportion of material covered in each I CARE content, the extent of interaction with tutors, and participation in group discussions.

5. Results

This section presents the results from the hierarchical cluster analysis revealing the learning behaviour patterns of the classroom and the distance students in terms of the I CARE components, as well as learner-tutor and learner-learner interaction.

5.1 Learning Behaviour of Classroom Students

Five distinct types of learning behaviour were identified amongst the first year sample, as reported in [2]. Four of the five types were found amongst the second year data. Figure 3 presents on average what proportion of the I CARE components was covered by all nine types. The four main components of I CARE are included: Content, Apply, Reflect and Extend.

The top two types of students were called 'Ideal' as these students consistently covered over 60% of the I

CARE components. These students also actively participated in group discussions.

The cluster, which included the cases categorised as 'Reflectors', represents students who covered on average 73% to 76% of the Reflect section. These students spent less effort on all other sections. In particular they covered approximately half of the Content and Apply materials, and one third of the Extend section. This cluster is unique to the first year study sample, and could not be identified amongst the second year sample.

The 'Social' learners, who populated a reasonably big cluster in each year, covered average amounts of each I CARE section, typically between 24% and 46%. These students, however, interacted with their tutors and peers extensively as part of their studying strategy, as their participated actively in group discussions and have consulted their tutors most regularly than the other students during the face-to-face sessions.
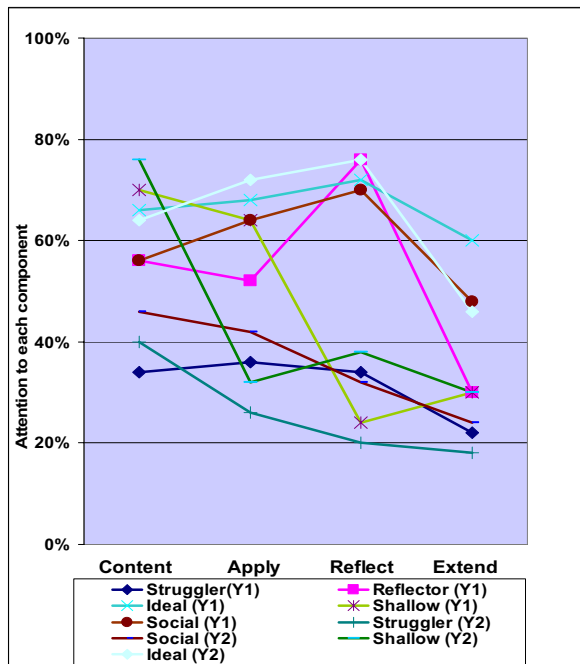

Figure 3: Proportion of each component of the I CARE model covered by classroom students according to learning behaviour type (%).

The 'Shallow' learners appear to have cover typically 70% of the first section, the Content, but then their performance gradually decreased.

Finally, two groups of students emerged who can be described as 'Strugglers'. The first year's group of strugglers covered 42 % of the Content and Apply component. They also covered very low percentage of

the Reflect and the Extend components, and their social interaction rates were the lowest in this sample of classroom students. In a similar fashion, the second year's group of strugglers covered only one third of the first three components and one fifth of the Extend element but their social interaction, although below the average levels, was considerably higher compared to the first year's group.

5.2 Learning Behaviour of Distant Students

With regard to the distant students, four clusters emerged in the first year study, three of which where identified amongst the second year's sample as well. In addition, some students from the latter sample exhibited similar behaviour to the 'Shallow' learners, as identified amongst the classroom students. The extent to which they covered each I CARE component is presented in Figure 4.
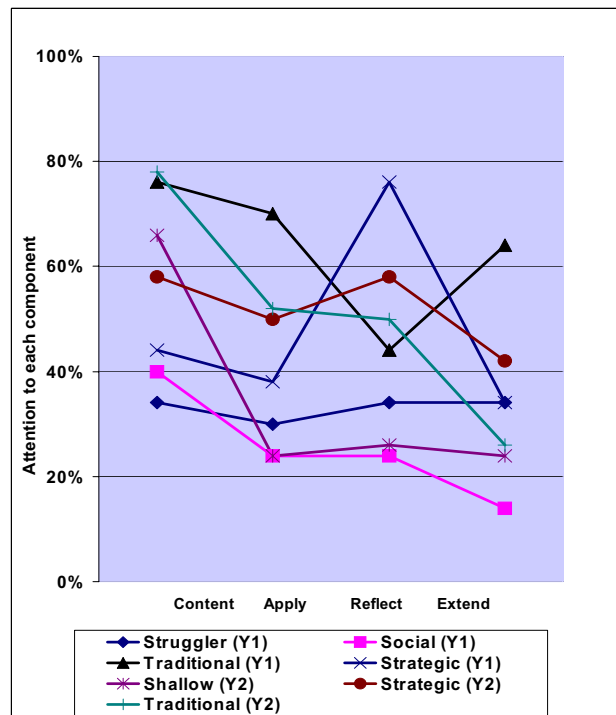

Figure 4: Proportion of each component of the I CARE model covered by distant students according to learning behaviour type (%).

The 'Traditional' learners displayed high performance across the I CARE components, although their learner-learner and learner-tutor interaction was limited.

The 'Strategic' learners employed a distinct approach by covering selectively the Content element

(44%) but showing a strong commitment to the Reflect section (76%), which contains exam-like questions.

The 'Social' learners again covered an average proportion of the I CARE components, however high learner-learner and learner-tutor interaction was the most prominent feature of this group of students.

The 'Strugglers' presented a performance which covered approximately one third of the materials in each component, typically between 30% and 34%.

Finally, the 'Shallow' cluster represented students who had read most of the Content component, but were involved to a lesser extent with the Apply, Reflect and Extend sections.

6. Discussion

The findings of the study provide evidence of the flexibility of the I CARE pedagogical framework according to two of the three criteria studied. Students seemed to have engaged in different learning tasks that may suit their learning strategies better. The structure of the learning environment provided students with guidance through the materials, and sufficient flexibility to traverse the material in the sequence that best suited their learning preferences. Although synchronous and asynchronous communication tools were included in the learning environment, as they were not well integrated with the learning tasks, they were rarely used.

The results also highlighted two groups of students who might not have been well supported: the Social Learners and the Strugglers. The Social Learners seem to actively engaged in collaborative learning, especially during the face-to-face seminars, however this was outside the I CARE components. One possible explanation for the behaviour of the Strugglers might be that they could not easily adapt to the open mode of learning. Perhaps these students were more accustomed to traditional approaches to teaching and needed further support in adapting to the novel learning environment.

While the study provides some empirical evidence of the flexibility of the I CARE pedagogical framework, limitations exist that reduce the reliability of the results. Firstly, the response rate of students varied across sample groups, and was particularly low for the distance students in year one of the study. Secondly, student learning behaviour would also have been influenced by factors, such as prior domain knowledge, prior experience with e-Learning, and computer literacy, which could not be controlled in the study.

7. Recommendations

In order to facilitate these types of students in their learning, a number of improvements can be introduced to the e-Learning environment. Some of them include:

- Provide students with a selection of individual and group learning tasks and activities and meet the learning objectives of the course.
- Develop online facilities that encourage meaningful online communication and collaboration between students as well as between tutors and students and integrate them with the learning tasks.
- Provide sufficient learner support mechanisms in e-Learning environments that are alternative to face-to-face scaffolding techniques.
- Ensure the needs of low-ability students are addressed by providing content and learning tasks at different level of complexity.

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