The teaching of RAD skills
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Abstract

RAD is an approach to systems development that necessitates careful management; it may mean large scale cultural changes for an organisation, since it requires the empowerment of developers to make critical decisions. Development of high levels of interpersonal and cooperative working skills are essential to successful facilitation and implementation.

This paper evaluates the introduction of this evolutionary approach on an undergraduate modular degree scheme. It considers the key concepts of RAD and reports on the students’ response to the joint application development approach together with their ability to cope with backtracking. It discusses the students’ reaction to focusing on the delivery of business functionality at the time of cut over, both as a measure of quality and course evaluation. It concludes that cultural changes may be required by an academic institution offering such a course of study and that a careful choice of tool, lecturer and assessment method are necessary prerequisites.

1. Introduction
RAD as an approach to developing Information Systems originated in the mid-1980s. The term RAD was conceived by James Martin and since its inception, the approach has been given much attention by the world of I. T. Prior to the onset of RAD as an approach, conventional systems analysis identified stages in the development of an information system as Feasibility Study, Systems Investigation, Systems Analysis, Systems Design, Implementation, Review and Maintenance.
These stages are often referred to together as either Traditional Systems Analysis, the Systems Development Life cycle or the Waterfall Model.

The conventional approach is well known and well utilised. It has been tried and tested, with formulation of standards within the documentation used and there is recognition of the importance of training to both developers and users. These conventional methodologies go part way to preventing run over of projects and encourage reviews at regular stages. The greater control over projects is achieved by dividing the process into stages and sub stages enabling the use of project management tools and techniques.

However problems still exist with the traditional approach. For example, failure to meet the needs of Management, unambitious systems design, instability and inflexibility in the final product. This may lead to user dissatisfaction, incomplete systems and an ever growing application backlog and maintenance workload. Research [1,2] shows that the conventional approach to systems development has not been realised fully by many organisations and a glance at the computing press will reveal that problems still exist. It is with the software crisis in mind that RAD is looked to, in order to provide a more complete approach for the development of software systems.

The desirable properties of a Systems development approach are that it should be adaptable to circumstances, minimise manual work by the use of computer where possible, allow developers to be creative but still give guidelines, checklists, and warn of pitfalls whilst still enabling flexibility. Moreover, it should be seen as appropriate by both developers and the users.

2. **What is RAD?**

Rapid Application Development is not a methodology, although RAD methodologies are being published; it is an approach, a development Lifecycle designed to give much faster development and higher quality results than the traditional Lifecycle. The advantages offered by a RAD approach to systems development are many; firstly, a lower cost is achieved, primarily through shorter development times with small development teams using power tools. The focus throughout is on quality as defined by the user in terms of developing the right system first time and in delivering a system meeting the true business needs at the time of cut over [4]

It should not be assumed that RAD is a magic silver bullet. It is not applicable to all areas of system development, lacking relevance to areas such as the development of complex operating systems for software tools, but it has been used to great effect in Information Systems development which are essential to every organisation. RAD's success is due in part to its emphasis on engaging users in the total development process. It transforms the software development life cycle from
a static, documentation orientation to a dynamic, evolutionary, interactive process. It offers high quality software, with quality defined by the user, on time and on budget.

The RAD process provides a forum for an ongoing 'conversation' between developers and users which involves both, in the development process throughout the cycle. RAD, in fact, provides a common platform for language, enabling developers and users to converse about business rules rather than technology, throughout the development process. The combination of effective RAD tools and the cooperative development approach, allows the Users to participate in the evolution of their application throughout.

3. Module Description
The RAD module at Staffordshire University was offered as a second level undergraduate module with no prerequisites or co-requisites specified. The primary aims of the module were to examine the approach of rapid applications development and to experience its mechanisms through the construction of system prototypes. The Indicative Content included:

- Prototyping: types of prototyping and the differences between them.
- Integration of prototyping with analysis and design methods.
- Constructing prototypes for specific analysis and design objectives.
- Use of prototyping languages, generic and application packages.
- Prototyping soft elements of problems.
- Evaluation of prototype operation.
- Design and evaluation of such approaches.
- End-user computing and its contribution to RAD.

Specific learning objectives were, that at the end of this module, a student should be able to:

- Discuss the RAD approach in contrast to more established modes of system development.
- Design and construct suitable prototype systems to implement systems for specific problems.
- Evaluate the effectiveness of prototyping solutions in given problem situations.

The Teaching, Learning and Assessment Methods were stipulated as:

"RAD is a practical topic and this will be reflected in the teaching strategy of the course. Students will be monitored, singly and in groups, in devising and constructing prototypes using a variety of facilities. Lectures will support the learning of appropriate languages and packages, and will examine the context in which RAD is undertaken."

This was interpreted as follows:
The students were set the task of a realistic determination of the user requirements using a Rapid Application Development approach, resulting in the development of
a complete business solution. All work was group based and it was incumbent upon the group to follow a RAD approach in order to:

- Devise an appropriate methodology incorporating RAD techniques
- Devise a project plan:
- Determine the user requirements:
- Develop a system to satisfy the requirements:
- To develop a system following an evolutionary prototyping path
- To work effectively as a group:
- To communicate with the user/assessor:
- To adopt appropriate team roles:
- To become effective in the use of the chosen development platform.
- Divide work appropriately:
- Take part in all the assessment sessions.

**The User** was a physiotherapist working both within the Health Service and independently as a Private Consultant. He was not sure of his exact requirements and just how a computer system could assist him in his duties but felt that a computer based system to analyse his patient outcomes would be beneficial.

The students did not have a written specification and needed to determine the User’s requirements through a series of Joint Requirement Planning and Joint Application Development sessions to develop an evolutionary prototype. The assessment was formative and took place both at the JRP and JAD sessions but was based primarily on the final system and was graded according to the extent that the system met the true business needs at the time of handover.

The development environment combined the use of the SELECT case tool and Paradox for windows. Whilst Paradox may not be seen as the ultimate RAD tool, in conjunction with the select case tool it enabled the principle of RAD to be illustrated in a creative and rewarding manner. Lecture notes and other communications were facilitated using the World Wide Web.

### 4. RAD Questionnaire results

110 students undertook the RAD module for the first time in 1994/95. Module evaluation took the form of a computer based questionnaire after the work of Mclaughlin and Lovegrove [3].

A Likert scale was utilized to measure the strength of the views expressed; (1 being not very important to 5 very important)

\[
\text{i.e.: Very important} \quad 5 \quad 4 \quad 3 \quad 2 \quad 1 \quad \text{Not very important}
\]

The questionnaire was divided into sections pertaining initially to students background, prior knowledge, and their reasons for choosing the module; then
focusing on an evaluation of the delivery and assessment, together with students’ understanding of the concept of RAD.

The questionnaire was not compulsory and the percentages relate to the number of respondents. Information yielded is presented below, together with details of the questions asked.

**How important were each of the following in choosing the module?**

<table>
<thead>
<tr>
<th></th>
<th>Very (5)</th>
<th>4</th>
<th>3</th>
<th>2</th>
<th>1</th>
<th>Not Very</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sounded Interesting:</td>
<td>28%</td>
<td>50%</td>
<td>14%</td>
<td>6%</td>
<td>2%</td>
<td></td>
</tr>
<tr>
<td>Seemed Useful:</td>
<td>22%</td>
<td>50%</td>
<td>22%</td>
<td>6%</td>
<td>0%</td>
<td></td>
</tr>
<tr>
<td>No alternative:</td>
<td>3%</td>
<td>13%</td>
<td>34%</td>
<td>19%</td>
<td>31%</td>
<td></td>
</tr>
<tr>
<td>Lecturers:</td>
<td>25%</td>
<td>36%</td>
<td>28%</td>
<td>9%</td>
<td>2%</td>
<td></td>
</tr>
</tbody>
</table>

Comment: The RAD module was perceived at outset as being an interesting and useful area of study. Very few students regarded it as ‘Hobsons choice’. The lecturers were an important element in their decision. Other reasons given included “Industry is very interested in using RAD for systems development”, and “RAD seemed a good subject, up to date stuff”

**RAD and previous experience**

How well have you understood the concept of RAD?

<table>
<thead>
<tr>
<th></th>
<th>Very well</th>
<th>5</th>
<th>4</th>
<th>3</th>
<th>2</th>
<th>1</th>
<th>Not very well</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>21%</td>
<td>55%</td>
<td>24%</td>
<td>0%</td>
<td>0%</td>
<td></td>
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</tr>
</tbody>
</table>

Comment: The students claim to have understood the basis for a RAD project, with none claiming total ignorance of the concept.

**Approaches to systems development:**

How difficult do you find the following approaches to systems development?

<table>
<thead>
<tr>
<th></th>
<th>Hard (5)</th>
<th>4</th>
<th>3</th>
<th>2</th>
<th>1</th>
<th>Easy</th>
</tr>
</thead>
<tbody>
<tr>
<td>RAD approach</td>
<td>0%</td>
<td>17%</td>
<td>24%</td>
<td>39%</td>
<td>20%</td>
<td></td>
</tr>
<tr>
<td>Traditional approach</td>
<td>0%</td>
<td>32%</td>
<td>32%</td>
<td>29%</td>
<td>7%</td>
<td></td>
</tr>
<tr>
<td>OO approach</td>
<td>13%</td>
<td>38%</td>
<td>33%</td>
<td>14%</td>
<td>3%</td>
<td></td>
</tr>
</tbody>
</table>

Comments: The RAD approach is seen as a more accessible systems development method than either the traditional Waterfall approach which for the majority of Staffordshire students will be the SSADM methodology. Only The Object Oriented approach is seen as a very difficult approach by students.

**Evaluation of the module.**

How have you found the course?

<table>
<thead>
<tr>
<th></th>
<th>Very (5)</th>
<th>4</th>
<th>3</th>
<th>2</th>
<th>1</th>
<th>Not very</th>
</tr>
</thead>
<tbody>
<tr>
<td>How interesting</td>
<td>28%</td>
<td>55%</td>
<td>13%</td>
<td>4%</td>
<td>0%</td>
<td></td>
</tr>
<tr>
<td>How Useful</td>
<td>25%</td>
<td>55%</td>
<td>13%</td>
<td>7%</td>
<td>0%</td>
<td></td>
</tr>
</tbody>
</table>
Assignment relevance 40% 45% 15% 0% 0%
Assignment difficulty 15% 53% 25% 5% 2%

Comments: The module was well received by most of the students with very few questioning the relevance and difficulty level of the course of study. Suggested improvements to the course of study were that the speed of the PC’s needed improving.

Is paradox effective as a RAD tool?

<table>
<thead>
<tr>
<th></th>
<th>Very</th>
<th>4</th>
<th>3</th>
<th>2</th>
<th>1</th>
<th>Not very</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paradox RAD</td>
<td>10%</td>
<td>43%</td>
<td>40%</td>
<td>5%</td>
<td>2%</td>
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</tr>
</tbody>
</table>

Comment: Although Borland now claim their Delphi product to be a RAD tool, the development environment of Paradox for Windows seemed to be an acceptable RAD tool for most of the students following the module.

How useful has the internet been in distributing notes?

<table>
<thead>
<tr>
<th></th>
<th>Very</th>
<th>4</th>
<th>3</th>
<th>2</th>
<th>1</th>
<th>Not Very</th>
</tr>
</thead>
<tbody>
<tr>
<td>Internet Notes</td>
<td>13%</td>
<td>26%</td>
<td>46%</td>
<td>15%</td>
<td>0%</td>
<td></td>
</tr>
</tbody>
</table>

Comment: The majority of students found the use of the World wide web for note distribution, a useful technique allowing rapid dissemination, minimal cost and full colour imaging.

5. Pedagogic Perspectives

The essence of RAD as an approach is that it requires that developers make critical decisions based on the information given by the User. Interpersonal and cooperative working skills are vital to the success of this interaction and the quality of the information shared. When delivering a module on RAD, therefore, consideration of the approach most appropriate to the optimum realisation of these skills through the teaching and learning process, is critical. The approach to the module must reflect and develop skills in the individual which enable successful facilitation and implementation of RAD in the work place.

The approach chosen for this module was based on the concept of Experiential Learning as defined by Kolb. [5]. Learning is seen as a process whereby concepts are derived from and continuously modified and shaped through experiences, in a cyclical process of transaction between the learner and the environment. It is not an independent entity to be acquired or transmitted.

Relating this approach then to RAD as an Information Systems development process, the pertinence of Experiential Learning is clear. Both approaches depend on interaction and interaction between parties.
Satisfactory learning requires motivation to learn. Motivation as a concept can be divided, into extrinsic forms of motivation, imposed upon the learner, and intrinsic motivation, which comes from the individual him/herself. Assessing first the intrinsic motivators, research suggests that we may possess a natural curiosity drive that does not appear to be directed towards an apparent material end, but which is engaged in for itself and which prompts exploration and the pursuit of new learning experiences. Extrinsic motivators relate to achievement and success, measured in this environment in factors such as assessments and employment.

The RAD module, utilising the Experiential approach, together with practical assessment, has attempted to draw together both intrinsic and extrinsic motivators in the following ways.

- Seeking to introduce a different approach to teaching through an emphasis on experiential learning, with the lecturer acting as mentor of the process rather than purely pedagogic instructor.

- Facilitating a professional oriented set of skills, which have direct value and currency in the increasingly competitive Information Technology Industry.

- Offering an alternative method of assessment, measuring not simply knowledge and comprehension, but interpersonal and communication skills and the ability to work in a group; all of which are essential for successful employment in the Information Technology Industry.

6. Conclusions
Overall, the first iteration of this module has been a success. The module was generally well received by the students, who appreciated the formative approach and realised the benefits of joint application development through an evolutionary prototyping system approach. The majority of the students felt that the RAD module was relevant to their future careers in information technology, and the Experiential Learning approach was received favourably. It was seen as enabling the students both to express their creativity within the limits of team work, and develop practical interactive skills useful in the I.T. Industry. The students' interpretation of the RAD approach resulted in many and varied manifestations of the Users requirements. Indeed, despite the fact that the User continually refined his requirements, the students maintained an enthusiastic and successful interpretation to their project. They did not express an adverse reaction to the assessment focusing on quality at the point of delivery. Data from the module evaluation relating to the learning culture, suggests that the careful choice of tool, lecturer and teaching method are important features of the success of the module.
Indeed the flexibility of both delivery and assessment, based on the concept of Experiential learning may not suit every lecturer. However, these factors need to be addressed in future implementations of the module if successful learning is to be achieved.

7. References


