THE COMPLEXITY OF THE E-LEARNING SYSTEM
A PARADIGM FOR THE HUMAN FACTOR

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Abstract. The purpose of this paper is to investigate how e-learning platform – TESYS – contributes to learning development activities. This paper is aimed at contributing to the increase of the understanding of the influence of the information systems on building new learning perspectives for different categories of users. The results reveal that there are statistically significant differences regarding the ages of the persons considered in the research, but their expectations and needs referring to the e-learning platform seem to be the same. The real differences come from the difficulties of the individual use of the facilities offered by the information systems and from the human factor's level of involvement in the improvement of this system. Consequently, there are visible discrepancies in the use of the e-learning platform and these disparities are not only age - and sex - related but also to the person's knowledge in the field.

1 Introduction

Specialists have been more preoccupied about the development of the information systems from the perspective of the technological informatics infrastructure, research devoted to the technology infrastructures embedded in the information systems lacking to some extent in literature.

The advantages of e-learning are presented both according to the relation between price and results - as a force for "profit and efficiency" and a source for competitive advantage (Swanson 2001), and according to the flexibility in delivery and flexibility in the pace and distribution of learning (Galagan 2000).

The academic literature is wanting, particularly in the area of human resources involved in e-learning and in the area of technological needs, learner support and evaluation.

In this context specialists have to pay attention both to the social and human aspects that accompany the introduction of an information system into an organisation.

The author of this paper hopes to have two significant contributions to the field.
First, we introduce some key ideas from the literature as well as the paper’s theoretical framework regarding the relationship between IS–HR and e-learning system. This section argues for a humanistic system development approach to e-learning in order to translate human resources requirements into a system that supports effective learning.

Second, the paper illustrates the difficulty of developing an e-learning platform for diverse student base.

The purpose of this study is to examine the impact of e-learning system on human system for the use a Tesys platform that incorporates both technical and learning features.

2 Information Systems versus Human System

Time pressure has become so powerful that neither the organisations nor the persons themselves pay attention to the human factor even if this factor can be a sine qua non of the information system development (ISD).

Specialists are mainly preoccupied with explaining how social phenomena shape both the development and use of technologies (MacKenzie and Wajcman 1999) or to analysing and interpreting the effects of information technology over the human factor in cultural or organisational contexts (Slaton and Abbate 2001).

The lack of dialogue between the specialists in the IT field and Human Resources (HR) generates severe dysfunctions within the two systems (technical and human).

Thus the human system bears the stress – it does not have skills for self-directed learning and technology management, it is not self-motivated, and is not prepared for isolation, while the technical system ‘suffers’ from its partial and inefficient use.

When the stage/limit of reciprocal exploring is over, the user passing on to “friendly collaboration”, the interaction between IS and HS (figure 1) leads:
- to continual perfecting and improvement of the IS quality, and
- also to the building up of further knowledge on the basis of others’ contributions, thus HS achieving new competences.

Fig.1. Interaction model between IS and HS

This model represents two key actors of the e-learning process (the IS and the HS) and, aware or not of the fact, the human actor needs to make decisions and incorporate their questions and assumptions into the IS with the purpose of improving the latter's quality (Orlikowski and Iacono 2001).
The results indicate that the HS's acquisition of competencies depends on the quality of the information system. Furthermore, if HS is a prior step in the feedback process, then the feedback process is influenced more by the competencies of the HS.

Thus, the design and implementation of the IS must be concerned not only with narrow technical activities, but also with organisational and social structures, and with the analysis of the necessities and expectations of the human factor.

As a result, e-learning could represent the mechanism by which the organisation transforms the individual’s knowledge into intellectual capital at different levels (individual and group levels, dependent or independent learners who study) and brings forth the opportunity that knowledge should to be achieved and shared (Burlea Schiopoiu 2003).

Furthermore, e-learning becomes an important engine for the development of the human factor and a technological solution to the economic, social and cultural problems of organisation.

For example, the use of e-learning system, through its potential of transforming implicit knowledge into explicit knowledge, has furthered instructional methods to improve student interaction, commitment, and motivation (Varlamis, Apostolakis and Karatza 2005).

E-learning environment provides the student with a relevant feature for acquiring and sharing knowledge (Pukkhem and Vatanawood 2005).

Furthermore, advanced technological solutions may provide structural support and guidance for the learning process through the implementation of active learning strategies.

3 Methodology

The method used in this study has been a mixture of qualitative methods and data analysis.

The semi-structured face-to-face interviews were carried on with the aim to examine the perceptions of the students regarding the information and knowledge that they can acquire by using the e-learning platform, and the factors that contribute to their finalising or quitting the courses.

Our research is an empirical inquiry that investigates the e-learning phenomenon within its real-life context (Yin 2003) and in connexion with the limits of the human factor.

In the research we employed a wide range of qualitative methods, which included direct and participative observation of the learners’ implication in the process of acquiring new knowledge by using the e-learning platform.

The interview protocol consisted of two sections: on the one hand, the level at which the e-learning platform corresponds to the needs and expectations of the attendants, taking into consideration the diverse age categories, and, on the other hand, their involvement in the improvement of the e-learning platform.

Because of the semi-structured nature of the research, the quantity and quality of data varied greatly between respondents.
The method of data analysis is a cyclic process that involves collecting data, analysis and theory generation until the grounded theory becomes formally related to the existing knowledge.

Because the interviews were taken at the end of the project, we needed to use two groups of persons for our research:

1. persons that have enrolled in the course and graduated from it - 42 persons (31 women and 11 men),
2. persons that have enrolled in the course and did not graduate from it - 31 persons (20 women and 11 men).

Ethical issues were observed, by inviting participants to take part in the two groups, and by giving them the option to withdraw if they felt uncomfortable and by making the results available for their further scrutiny to agree accuracy.

Content analysis was used to process the original texts of team project reports and the transcripts of interviews conducted. The participants were interviewed for a period of approximately one hour and they were encouraged to express their experience related to the use of the Tesys platform. Post analysis follow-up interviews with participants were used in order to confirm the validity of the results.

The SPSS was used to organise and categorise the large amount of qualitative data collected from documents and interviews.

The following questions guided the process of data collection (see table 1):

<table>
<thead>
<tr>
<th>QA. Questions referring to the information system (IS)</th>
<th>QB. Questions referring to the human system (HS)</th>
</tr>
</thead>
<tbody>
<tr>
<td>QA1. What is the relationship between the architecture of the e-learning platform and the types of knowledge that you need?</td>
<td>QB1. What were your expectations when joining this course and to what extent were they satisfied?</td>
</tr>
<tr>
<td>QA2. How did the using of the e-learning platform contribute to the improvement of the individual process of learning and acquiring new competences?</td>
<td>QB2. Do you think that acquiring new knowledge by means of the e-learning system is beneficial to you?</td>
</tr>
<tr>
<td>QA3. How did you evaluate the efficiency of using the e-learning platform?</td>
<td>QB3. How was your knowledge acquired in the e-learning system evaluated?</td>
</tr>
</tbody>
</table>

4 Study Design

This section assesses the use and implementation of e-learning application through case study.

The implementation of the approach used a platform for e-learning – Tesys –. This platform was funded in 2005 by the European Union project named “Training program via e-learning in the fields of economics and informatics for developing the labour force from the Oltenia region” (Burdescu and Mihaescu 2006). At present, the application is available and can be visited at http://stat257.central.ucv.ro
The main goal of the Tesys is to offer guidance in the learning process and to give possible solutions to several of their instructional needs, into both formal and non-formal learning process.

The Tesys application has the following structure: 3 sections, each consisting of 4 disciplines - contents range from technical knowledge to soft skills.

Each discipline is assigned to a section and has as attributes a name, a short name, the year of study and the semester when it is studied and the list of maximum three professors that teach the discipline. A course participant may be enrolled to one or more sections. All the course content was selected to reflect the needs of the students.

The information system is very complex and contains the following elements:

- support applications for the communication between students and their professors;
- support applications for on-line and off-line training;
- applications for the course participants' evaluation at exams;
- applications for creating, updating and using databases, with questions and problems;
- applications for statistic analysis: of the candidates’ results and of the test construction (difficulty, structure).

The platform itself is a web application used by administrator – sysadmin, secretary, professor in a collaborative manner in order to accomplish a learning process. Each of these four roles has been assigned a set of modules.

The e-learning platform needs to provide and support several categories of the ‘expectations’.

From the analysis of the e-learning architecture we can notice the accessibility to information of the students, irrespective of their status - novice, intermediate and advanced up to experienced – because, the platform provides and supports several categories of the ‘expectations’.

Course attendants have access to personal data and can modify them as needed. A feedback form is also available. It is composed of questions that check aspects regarding the usability, efficiency and productivity of the application with respect to the student’s needs.

After successful course completion, the students received a diploma by the providing academic institution – the University of Craiova.

5 Data Analysis

In order to emphasise the factors that influence the relation between the e-learning system and the students involved in the project we have studied the following variables: age and sex.

At first, in order to take part in the course, 722 candidates aged between 21 and 64 years old have enrolled (see Table 2).

Data analysis shows that there is statistically significant age differences between persons considered in the research.
Thus, 499 women (69.11 per cent) showed interest for the online course and only 223 men (30.89 per cent).

**Table 2. Structure of student groupings**

<table>
<thead>
<tr>
<th>Age categories</th>
<th>Gender</th>
<th>Total</th>
<th>Per cent</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Female</td>
<td>Male</td>
<td></td>
</tr>
<tr>
<td>21 – 22 years</td>
<td>15</td>
<td>6</td>
<td>21</td>
</tr>
<tr>
<td>23 – 30 years</td>
<td>171</td>
<td>105</td>
<td>276</td>
</tr>
<tr>
<td>31 – 35 years</td>
<td>130</td>
<td>35</td>
<td>165</td>
</tr>
<tr>
<td>36 – 45 years</td>
<td>66</td>
<td>20</td>
<td>86</td>
</tr>
<tr>
<td>46 – 50 years</td>
<td>64</td>
<td>21</td>
<td>85</td>
</tr>
<tr>
<td>51 – 61 years</td>
<td>53</td>
<td>35</td>
<td>88</td>
</tr>
<tr>
<td>61 – 64 years</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Total</td>
<td>499</td>
<td>223</td>
<td>722</td>
</tr>
</tbody>
</table>

The structure according to age categories is not homogeneous; the groups between 21 and 45 years of age represent the main part (75.90 per cent).

These first statistics made us look into the causes that might lead to these discrepancies and we have catalogued them into:

1. **human causes** – lack of interest for the course subject,
2. **technological causes** – course performance system by using the e-learning platform.

The activity of the course participants varied widely and only some of them completed the whole period of the project.

In order that our study to be valid we followed the statistical evolution of the learners till the end of the project and we noticed that only 412 persons (57.06 per cent) aged between 23 and 61 (see Table 3) graduated eventually.

**Table 3. Structure of graduating student (GD) and of non-graduating student (NG) groupings**

<table>
<thead>
<tr>
<th>Age categories</th>
<th>Gender</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Female</td>
<td>GD</td>
</tr>
<tr>
<td>23 – 30 years</td>
<td>92</td>
<td>49</td>
</tr>
<tr>
<td>31 – 35 years</td>
<td>74</td>
<td>17</td>
</tr>
<tr>
<td>36 – 45 years</td>
<td>39</td>
<td>9</td>
</tr>
<tr>
<td>46 – 50 years</td>
<td>55</td>
<td>9</td>
</tr>
<tr>
<td>51 – 64 years</td>
<td>46</td>
<td>13</td>
</tr>
<tr>
<td>Total</td>
<td>306</td>
<td>106</td>
</tr>
</tbody>
</table>

The results indicate that there are statistically significant differences between the ages of the persons considered in the research, but their expectations and needs related to the e-learning platform seem to be the same.

Despite the fact that many course participants failed to gain the required new competencies, most of them welcomed the insights and new ideas they acquired through the on-line discussions.
The Complexity of the E-Learning System - A Paradigm for the Human Factor

The final results made us think more about the fact that responsible for the learners having quitted the course might be the information system (IS) - the e-learning platform.

However, these results made us think about the fact that the information system (IS) – the e-learning platform could be “responsible” for the giving up of the course, because the course participants felt they should have direct access to resources that support active, independent, and self reflective learning.

At this point, it is impossible to draw any general conclusions from this preliminary evaluation, because it is only a statistical approach. New analysis is necessary in order to gain practical insight and, to generate some evidence-based claims about the e-learning platform possibility and limitations (e.g. lack of personalisation or lack of collaboration and interactivity).

6 Results

The course participants' satisfaction is the perception of the distance between the created needs and expectations, and what they have received through the e-learning system. The students' motivations for attending the course are different, whether they graduated or not.

In table 4 it is presented a hierarchy of these motivations after having analysed the interviews.

Table 4. Motivations referring to the information system (IS) and to the human system (HS)

<table>
<thead>
<tr>
<th>1. Mis. Motivations referring to the information system (IS)</th>
<th>Per cent</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>persons that have graduated</td>
</tr>
<tr>
<td>Mis1. They have considered that at the end of the course they would have more knowledge than at the beginning of it, as well as more practical competences in using an information system, a fact that might open up new professional perspectives for them.</td>
<td>100</td>
</tr>
<tr>
<td>Mis2. The newness of the online way of acquiring knowledge independent of time and place</td>
<td>95.24</td>
</tr>
<tr>
<td>Mis3. The perception of the utility of the e-learning system</td>
<td>90.48</td>
</tr>
</tbody>
</table>

| Mhs1. The ample curricula of the courses and possibility to attend a desired number of sections at the same time – new competencies | 100 | 100 |
| Mhs2. The fact that the course was free of charge - the cost advantages were also considered in relation with the costs saved on travelling and time away from the job | 57.12 | 38.71 |
| Mhs3. The possibility of obtaining a certificate that might give a certain professional stability to the course participants | 11.90 | 25.80 |
Participants’ response analysis elicited the main reasons that motivated them to attend the course as being related to those referring to the information system, a fact that leads to the conclusion that the e-learning system proved very attractive (see table 5).

Table 5. Answers referring to the information system (IS) and to the human system (HS)

<table>
<thead>
<tr>
<th>AnA. Answers referring to the information system (IS)</th>
<th>AnB. Answers referring to the human system (HS)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>AnA1.</strong> All activities are related to student outcomes and objectives Navigation may cause confusion</td>
<td><strong>AnB1.</strong> Course materials are easily to locate, accessible</td>
</tr>
<tr>
<td><strong>AnA2.</strong> Technology requirements are well explained Objectives and questions are given and written in such a way that they are clear and measurable</td>
<td><strong>AnB2.</strong> All the interviewed people agreed that it is beneficent for them to achieve new knowledge through the e-learning system, the novice from the 51-64 age group considered that the classical learning system is more “comfortable” for them, because during the programme they often felt lost and frustrated.</td>
</tr>
<tr>
<td><strong>AnA3.</strong> Assessment measures student progress towards course material The relationship between cost/ knowledge/ time is efficient The platform provides frequent and timely feedback Interaction between student-professor is facilitated by the use of communication tools</td>
<td><strong>AnB3.</strong> The course participants considered that, through the e-learning system, their knowledge is valued in a superior way, and at the same time it offers them the possibility to manage time efficiently. Consequently, there is a close connection between the period of time allotted to the course and personal time available</td>
</tr>
</tbody>
</table>

However, some course participants quit the course for varied reasons:

- all the persons that have been interviewed no matter the age class, indicated as main cause of giving up – the insufficient time to finalise the chosen course type.
- the persons between 51– 64 years old said they had given up the course because it was no longer useful for the development of their professional career.
- the persons between 46 – 51 years old said they had given up the course because they did not have enough knowledge to use the platform and that is why they could not finish tests in time.
- 80.65 per cent of the persons that were interviewed said they had enough knowledge in order to use the information system and especially because it is attractive and motivating to acquire new knowledge, but the main shortcoming consists in the fact they did not have access to computers in the time interval they wanted to assign to studying. Consequently, for this category of course participants’ technology was one of the main barriers to the development of the e-learning strategy.
From the analysis of the interviews we conclude that the e-learning system will become an important means of acquiring knowledge, for all categories of course attendants, irrespective of age, sex and level of knowledge in the informatics field.

The perception of course attendants' needs and expectations varied from group A – GD (at group A level the e-learning is perceived as a system that limits the level of interactivity) to group B – NG (at group B level the e-learning is the most popular form of learning), due to the diversity of the age categories and to the different levels of knowledge in the field of using the information systems.

From the analysis of the interviews we have noticed that we were confronted with a lack of clear goals and a lack of prioritisation of course attendants' needs. Further, because e-learning was relatively new as learning system there was a lack of direct interaction with the course attendants.

Consequently, the team project did not meet the course attendants' different needs stemming from professional differences in expectations and practices:

Through Tesys platform the difference of perception between the needs and the expectations of the course attendants is eliminated because those who have created the platform are in permanent contact with the former.

7 The Scenario of the TESYS Platform Perfecting

In our survey, general satisfaction regarding both the content and interface of the Tesys was reported, but review of the interview data revealed the importance of improving the e-learning platform.

In order to meet the needs and expectations of the different categories of users, the Tesys platform should have certain characteristics:

1. **it has to be rapid** - on the one hand to prevent the user from abandoning the e-learning activity if the computer does not respond very quickly - Horwath (1999) recorded anxiety in novice users when the technology failed to respond within 15 seconds -; and on the other hand, in order not to make out of the lack of free time for studying the main reason of abandon.

2. **it has to be simple** – so that the user, irrespective of the level of knowledge of informatics, should be able to manage the system and stimulate the growth of the user’s responsibility for their own learning in the release of personal potential.

3. **to allow the development of the users’ creativity** – by a strategic use of the connection between personal experience and technological performance of the Tesys platform.

4. **to have a high motivational level** in order to attract people of the age categories between 21-35 years old who had abandoned the course in a high proportion – 74.19 per cent of the total number of people who abandoned the course (see Table 3).

The process of perfecting the platform has followed, on the one hand, the growth of the platform accessibility level for those who had minimal knowledge of using the
information systems, and on the other hand, the increase of the platform complexity level for those who had multiple competences in using the information systems.

Moreover, it is essential to improve students’ satisfaction by means of increasing the quality of the platform. Consequently, technological capability and interactivity of the e-learning platform are fundamental.

The team charged with the improvement of Tesys platform consists of specialists in the fields of informatics, management of human resources, and in the management of business affairs.

This diversified structure of the team favours the elimination of barriers that were identified during the interviews.

For the Tesys to satisfy the different needs and expectations of the users, team project considered using the „computer-game” method to reconfigure the e-learning platform, so as to encourage attendance, enhance attention, increase interest and promote interaction between course attendants.

By defining each level the exigencies of the course attendants can be expressed through close levels. For example if “informatics knowledge” is minimal, these pieces of knowledge are levels 0 or 1.

Consequently, passing from level 0 to level 1 can be done only after the course attendants have obtained the minimal score for level 0.

The iterative process repeats itself for each level and it reaches the next stage - e-learning modules are created, taking into account the clients’ demands and resource management, planning and capitalisation constraints. Thus, the course attendants are helped to identify the relevant course from the level available to them.

First, because time constraints were indicated, especially by the course attendants who had abandoned the course, as being a significant barrier, the working out of a three-dimensional correlation strategy between the initial knowledge level of the participants, time constraints, technical and cultural background of the students was pursued – this shortcoming can be transformed into a competitive advantage.

Through Sysadmin – the course attendants are assisted in order to manage their time and reduce anxiety levels and the negative perception about a course perceived as difficult. It is also possible to use the platform to conduct multiple choice examinations, eliminating, thus, time constraints.

Second, the students’ degree of accepting the e-learning material was improved, a barrier which was mentioned especially by the students who had abandoned the course, as being a powerful de-motivating factor. Another difficulty faced by the students was the fact that they had to work hard when they were supposed to answer different questions which had scarce explanation in the course.

The collecting and processing of the students’ requests led to the elaboration of courses structured on levels of competences, the platform monitoring user activity through a log file which records each executed action.

The new courses deal with technology, billing and computer applications, soft skills, management and strategy covering a lot of topics.

Consequently, these courses are more accessible, include more information and are more logical.

Third, course attendants’ autonomy has increased and also the assessment of their experience.
Individual learning processes are conducted by emotions and feelings and every individual student creates his/her own interpretation of perceived information. As a consequence, by perfecting the Tesys platform individualised feedback was supplied to each student, reducing the degree of uncertainty and enhancing motivation.

From the moment in which a course attendant is registered to a course, a personal profile will be elaborated depending on various variables like: age, sex, competencies, skills, initial knowledge level, learning style, personality, motivation, goals and expectations. Consequently, course attendants may download only course materials for the disciplines that belong to the sections to which they are enrolled. They can take tests and exams with constraints that were set up by the administration through the year structure facility.

**Fourth**, the technological barriers have been eliminated by implementing some technological solutions that reduced the level of sophistication of the Tesys platform, a fact that lead to reducing the course attendants' frustration and the growth of their degree of satisfaction and their reliance on self-instruction and self motivation.

The solutions for reducing the level of sophistication of the platform had the following consequences:

- the increase of interactivity and integration,
- better formative assessment of students,
- reducing students' frustration,
- increasing levels of satisfaction,
- improving attendance.

In this way, the e-learning platform can no longer be considered a barrier to the full realisation of course attendants' potential, and the continual furthering of the e-learning platform has become very important for the improvement of the learning process quality.

**8 Conclusions**

The themes that emerged from this research show how course attendants value their relationship with the e-learning system and that their educational experience is influenced by the learning platform.

Although statistically speaking, we had a diversified population from the point of view of age, sex and level of knowledge in informatics, the main barrier in accepting e-learning was represented by the complexity of the Tesys platform.

The difficulties of individually using the facilities offered by the information system were signalled more frequently by the categories of age from 46-64 years old and mainly by women.

The structure of the e-learning platform has to encourage participation and insure the fidelity of all course attendants irrespective of age.

This will be possible only by means of a technology that promotes collaboration and provides mixed solutions.

Most importantly, the use of the e-learning platform depends on several learning contexts and students’ age levels.
The degree of the human factor involvement in improving this system was greater in the age segment of 21-35 years old. Irrespective of sex people were interested in improving the Tesys platform.

The role of the team project is that to incorporate course attendants' both technological and pedagogical preference perspectives into their use of the e-learning platform in order to valorise the training e-learning experience.

The advantages of an e-learning pedagogy are not fully exploited because of the limitations in technology and other strategic human priorities.

Further research is needed to understand how the course attendants engage in the e-learning system, and whether a relationship between students' commitment and e-learning system is possible.

This is essentially due to the role of course attendants' commitment in predicting success of the e-learning system, because the course attendants' commitment may be a more important factor than student satisfaction in the link to knowledge.

The relationship between the human factor and technological complexity could represent emerging issues that warrant further research, because e-learning has become an important source of organisational learning with a significant impact on employee performance.

References


