International Journal of Engineering, Business and Enterprise Applications (IJEBEA)

www.iasir.net

Our Experience Using Performance-centered e-Learning in Interdisciplinary Curriculum in Investment Management in Telecommunications

Silviya Stoyanova-Petrova[1], Nadezhda Kafadarova[1], Nevena Mileva[1]
Department of ECIT
Plovdiv University "Paisii Hilendarski"
24, Car Asen str., Plovdiv 4000
Bulgaria

Abstract: *This paper reports our experience in the development of an interdisciplinary curriculum at the point of intersection between investment management in telecommunications for a joint MSc degree and the evaluation of the curriculum. Lecturers and professors from three faculties of Plovdiv University participated in development of the "Investment Management in Telecommunications" (IMT) Master program curriculum - the Faculty of Physics and Engineering Technology, the Faculty of Philosophy and History and the Faculty of Economics and Social Science.*

The IMT master's program prepares students for work in the field of telecommunications, electronic commerce and business connections. The method of learning, which is implemented in this program, is performance-centered as it uses a virtual platform DIPSEIL.

In this paper we present the evaluation strategy which we have been applied to evaluate the proposed curriculum and some results we have achieved. The evaluation strategy aims to study the total purposes of the project, namely: 1. Quality Indicators of Efficiency in the IMT Master Degree Curriculum; 2. Quality indicators of Efficacy in the IMT Master Degree curriculum - Students' achievement; 3. Quality indicators of Satisfaction in the IMT Master Degree Curriculum - Course Evaluation Questionnaire.

Keywords: *master program; education; e-learning; performance support system; interdisciplinary education; curriculum evaluation; project-based learning*

I.   Introduction

The conducted preliminary studies on preferences of students, teaching strategies in universities and the requirements for preparation of specialists for industry have shown that there is a need to develop a complete Master program at the point of intersection between investment management and telecommunications.

The "Investment Management in Telecommunications" (IMT) program is a new program which is designed to address the market need for highly skilled technical managers in the telecommunications industry that have a broad knowledge across both technology and business. This new program exploits the established and high successful portfolio of communications BSc and MSc modules run by the Faculty of Physics and Engineering Technology in combination with five specially designed business modules to create a new MSc degree in Investment Management in Telecommunications. These five business modules draw on the experience of leading experts from academia in the area of business planning, financial and management accounting, regulation, marketing and product management.

The master program "Investment Management in Telecommunications" is developed within the research project "Implementation of project-based learning in an interdisciplinary master program" within the research project competition "Research 2011/2012" of the "Research & Development" division of Plovdiv University.

This program aims to provide the management tools and techniques of an IMT but with the focused application to the specific industry that an MSc can provide. It is aimed at both recent graduates and those with experience who seek accelerated progression to senior management and technical positions. The graduates of this new program are expected to be highly attractive to employers across a very diverse range of sectors.

Investment management in telecommunications in a unique way provides:
- New ideas and creative thinking in the telecommunications sector;
- Rapid response to emerging trends and developments;
- Identification of the best practice in the sector;
- Innovative techniques.
- The master program "Investment Management in Telecommunications" has set a goal the students to:
- Learn to respond effectively by technical competence, combined with good business skills to the high demands of rapidly growing communications industry;

- Gain advanced technical knowledge of telecommunications applications, integrated with a solid training in business management.

In a performance-centered approach to learning this would mean that students are instructed to perform an authentic task, related to their future job, and are provided with access to a full range of information such as data, images, advices, tools, assessment and monitoring systems [1], while performing this task. As a new technology, performance-centered educational systems have a strong potential to help students mastering job-related skills and to perform the task at hand with minimum support provided by others.

The project-based learning, which will be implemented in this master program, will use a virtual platform DIPSEIL (Distributed Internet-based Performance Support Environment for Individualized Learning) [2] for performance-centered reusable learning materials development. DIPSEIL is an integrated electronic environment, which is available via Internet. It is structured to provide individualized online access to the full range of information, guidance, advice, data, images, tools and software to permit the user to perform a task with a minimum of support and intervention by others.

II. The Aims of the Master's Program "Investment Management in Telecommunications"

A. *The Master Program Curriculum Design*

Master's program "Investment Management in Telecommunications" is designed for students who have obtained Bachelor degree in engineering or economics. They need high-quality modern education materials, the possibility of self-assessment in terms of their knowledge and skills and training steps for improvement - courses that will provide them with knowledge about the latest advances in telecommunications and investment management.

This master's program prepares students for work in the field of telecommunications, electronic commerce and business connections. Communications are more complex and dynamic than ever, creating the need for qualified telecommunications management experts.

The proposed curriculum of this program includes knowledge that managers of corporate or government communications must have, as well as vendors or consultants who are responsible for planning and implementation of broadband and wireless communications to transfer out voice, video or data. It combines the creation and maintenance of communications networks and systems solutions, including management of large annual expenditure for acquisition, installation and maintenance of telecommunication products and services. Students will have the opportunity to learn specialized elective courses in project management and communications, technology opportunities and perspectives for innovation in telecommunications, introduction to information theory, entrepreneurial finance and venture capital and others.

The program is designed around a core curriculum that provides a solid technical foundation and management background. The program requires students to successfully complete 10 courses (5 Technical and 5 Business) and to complete their education by preparing a MSc thesis. Students can apply to study the program over 1.5 year full time or part time [3].

The subjects included in the curriculum have the distribution described below:
- Eight compulsory subjects;
- Two elective courses (students choose from a list containing six subjects);
- 50% of subjects are in the field of physics and telecommunications;
- 50% - economic and social disciplines.

As the program keeps up with industrial trends, these courses focus on emerging, cutting-edge topics. Students may choose from a wide range of electives to develop their interests and complement their career goals.

The content of the curriculum includes the following subjects, divided into three semesters (Table 1, Table 2 and Table 3).

Table1

№	I semester Courses	Abbreviation
1	Physical foundations of telecommunications	C1
2	Physical foundations of the propagation medium, components and devices for telecommunications	C2
3	Innovation and Entrepreneurship	M1
4	Entrepreneurial finance and risk capital	M2

Table2

№	II semester Courses	Abbreviation
1	Introduction to telecommunication systems	C3
2	Information technology	C4
3	Innovative marketing	M3
4	Applied Statistics	M4

Table3

№	III semester Courses	Abbreviation

1	Special elective course from: • Project management and communication; • Technological opportunities and perspectives for innovation in telecommunications; • Introduction in the theory of information.	C5
2	Special elective course from: • Economics of technical change; • Strategies for risk management; • Multi selection choice of project solutions: some practical algorithms.	M5
3	MSc thesis	-

B. *Instructional Design for Performance-Centered Course in DIPSEIL*

It is important that the performance in education that is supported is related to performance in students' future working environments. During the course, students should be confronted with and trained for situations they will also encounter in their future profession:
- Identify the reference situation of a particular course. These are the professional settings where students are going to apply in practice what they have learned during the course.
- Define a set of authentic problems and develop tasks related to a specific working environment.
- Shift the instructional focus from knowledge and understanding (i.e., the lower levels of the learning taxonomy), towards solving real-world problems (i.e., the higher levels of the learning taxonomy).
- Applying adequate summative performance-oriented assessment methods.

DIPSEIL is a performance-centered learning environment. The system has elements of performance system, elements of traditional Web-based educational programs and automatic test system. The system uses a new technology for improving students' competency and performance by providing support for processing, analysis and reflection on information and learning experience. DIPSEIL has two specific characteristics:
- The learning content is based on learning tasks. Performance tasks aim preliminary at specified learning outcomes.
- There will be no lectures, practical or final examination. Students only perform the learning tasks throughout the semester and collect credits for each learning tasks they perform adequately. They receive a final mark at the end of the semester based on the collected credits.

Each learning task consists of the following elements:
- Task description - the learning tasks is described, explaining the students what is expected of them.
- Reference information - task relevant resources that support students by making immediately available information, which they either have to study or use just in time to perform the task.
- Task-specific training - training materials which help the user to learn while performing the task.
- Instructions how to perform the task - the students are provided with the steps that should be taken in order to solve the problem or complete the task.
- Expert advice about a task - expert advice part contains specific advice on performing tasks.

The curriculum structure implemented in DIPSEIL system is shown on Fig.1.

Some examples of the "Physical foundations of telecommunications" course and the "Entrepreneurial finance and risk capital" course are shown on Fig.2 and Fig.3.

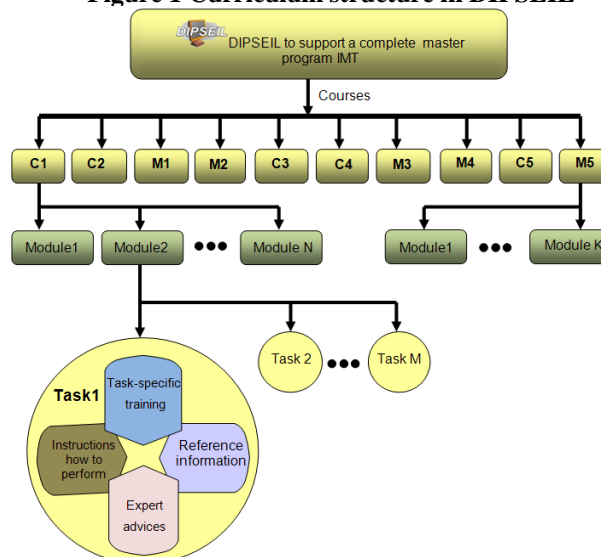**Figure 1 Curriculum structure in DIPSEIL**

Figure 2 Task specific training of the "Physical foundations of telecommunications" course
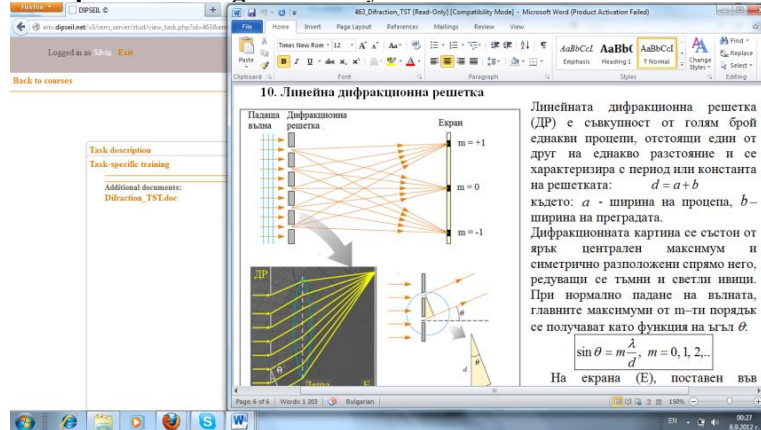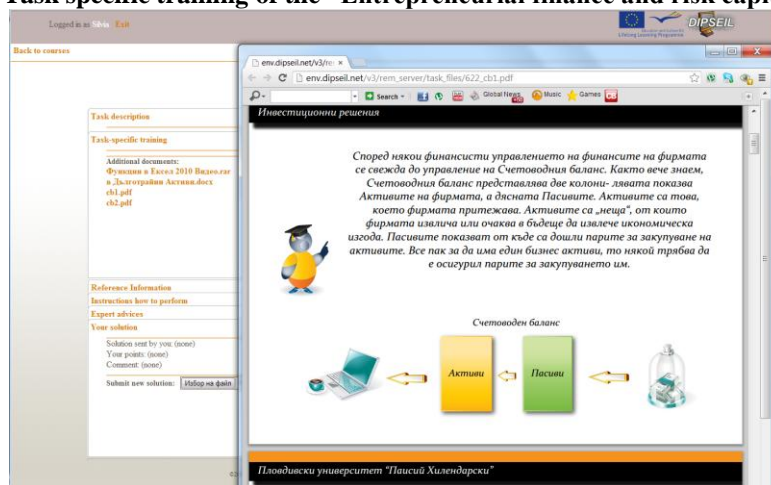

Figure 3 Task specific training of the "Entrepreneurial finance and risk capital" course

III. Curriculum Evaluation

A. *Evaluation Strategy*

The evaluation strategy in the project aims to study the total purposes of the project, being our main objective to validate the IMT curriculum [4], namely:

1. Quality Indicators of Efficiency in the IMT Master Degree Curriculum
   - "Attitude towards Learning by Computer Questionnaire".
   - The usability and functionality of the platform. "Computer System Usability Questionnaire".
2. Quality indicators of Efficacy in the IMT Master Degree curriculum - Students' achievement.
3. Quality indicators of Satisfaction in the IMT Master Degree Curriculum - Course Evaluation Questionnaire.

To know if our innovation gets the outcomes pretended on efficacy, efficiency, and satisfaction, is essential to obtain evidences from the benefices of our purposes, about:
   - How was carried out the learning process;
   - Which ones of our proposed outputs have been achieved;
   - Which one of our proposed outputs need be improved;
   - For internal transparency in the institution, and quality assurance.

Students group characteristics:

The courses started in March of 2012 in Plovdiv University. In this paper we present the results of the courses' evaluation till that moment. The group's age shows a mean of 27 years, where the youngest student is 24 years old, and the oldest is 33 years old. Six students are men, only one is woman.

B. *Results from the "Attitude Towards Learning by Computer Questionnaire"*

The students that are enrolled in the IMT Master Degree in Plovdiv University, were asked to answer a short questionnaire about "Attitudes towards learning by computer", in order to know the initial students' attitudes towards this modality to learn. "Attitude towards Learning by Computer Questionnaire", applies a Likert scale, valuing every item from 1 to 5, minimal to maximal agreement with a particular statement in the questionnaire. It was answered by 7 students. For 2 students this was their first course on-line.

The items with high score:
- I find very positive the idea of using computers and Internet by study different subject matters (mean 4.71);
- I feel very comfortable in Internet-based environments (mean 4.57);
- I learn better when:
  - a. Looking at examples and demos (mean 4.57);
  - e. Doing and practicing (mean 4.86).

The global mean in the questionnaire: 4.01, shows a positive students' attitudes towards learning by computer.

C. *The Usability and Functionality of the Platform. Computer System Usability Questionnaire*

The evaluation of the 'usability and functionality of the platform' deals with how well the platform satisfies the user needs and requirements. Because the learning environment during our research project is the DIPSEIL platform, it was necessary to collect the students' opinions about how the system works.

The students who belong to the IMT Master Degree, in Plovdiv University, were asked to answer this questionnaire. The questionnaire contains 19 items in total applying Likert scale, from 1 (totally disagree) to 7 (totally agree).

From 7 students involved in the Programme, 7 filled in the 'Computer System Usability Questionnaire'.

All items have been carefully evaluated by the students, most of the scores were over the central value of 4, (range of 1 to 7), with a mean near to 6.

The items which have been highly valuated are:
- It is easy to find the information I needed (mean 6.71);
- It is simple to use the system (mean 6.71);
- The information is effective in helping me complete the tasks (mean 6.57);
- The organization of information on the system screens is clear (mean 6.14).

D. *Quality indicators of Efficacy in the IMT Master Degree curriculum - Students' achievement*

Efficacy indicators are usually based on the discrepancy between final results and Program goals. So we need to check if the IMT curriculum has been effective finding out whether the goals have been achieved.

We need to measure the student's achievement in knowledge, performance and attitude, but especially in performance because our instructional IMT Model is characterized by students' performance-centered learning.

Also it is important to evaluate the results in the institution that had applied the IMT Master program in order to know the achievement in new way of learning and in innovation by professors and instructors involved in the project. To measure this kind of indicators we need to check participants' achievements.

Every course contains modules. Depending on the complexity and applicability of the module content, the students were required to solve one, two or more tasks. But in total, every course contains 8 tasks. The scale to evaluate the students in Bulgaria, use a range from 1 to 6, needing a 3 to pass the exam. Nevertheless, the scale used in the two courses which we present, have been transformed in another from 1 to 10, more frequently used in other European countries. After the students solve each task, the teachers provide the students' marks for it.

The Table 4 shows the achievement results of 4 courses in the first semester.

Table 4 The 'Achievement in competences development' results

Course	Students	Tasks	Range	Mean	St.D.
Physical foundations of telecommunications	6	8	1-10	8.0	1.0
Innovation and Entrepreneurship	5	8	1-10	8.6	0.68
Physical foundations of the propagation medium, components and devices for telecommunications	7	8	1-10	8.5	0.87
Economics of technical change	7	8	1-10	8.2	0.99

The global means in these four subjects, coursed in the first semester, give the value of 8.0 and 8.6, in one range from 1 to 10, showing a high students' achievement in both subjects.

E. *Quality indicators of Satisfaction in the IMT Master Degree Curriculum - Course Evaluation Questionnaire*

Besides efficacy, the usefulness of the curriculum in terms of its perception by students must be checked.

The satisfaction with the IMT curriculum is measured in relation with the IMT curriculum goals, and with the implementation process and their results. Satisfaction is considered as a measured of impact.

For this purpose, we have developed a questionnaire to assess the course. It consists of 20 questions, divided into four sub-scales according to the quality indicators, namely: relevance, effectiveness, efficiency and satisfaction. The questionnaire uses five point scale Likert (1 = strongly disagree, 5 = strongly agree).

The "Course Evaluation Questionnaire" pretends to measure the students' satisfaction with the IMT curriculum, in relation with the IMT curriculum goals and with the implementation process, included the platform, and their results.

We believed that it would be a good idea to start with a question on the impact of the course on the students. We asked them if they would recommend the course to others -some friends-, putting the students in one situation to

reflect about their satisfaction (or not) on the course quality, and to finish with a general questions on the course and the platform. After all, the project research has to do with "Learning" and with "Internet".

Quality indicators in the questionnaire are:
- Learning Model;
- Platform (DIPSEIL environment);
- Main and overall purpose of the course.

The "Course Evaluation Questionnaire" is addressed the students that had following the courses in the IMT Master Degree, and should do one evaluation for every courses just when they finished them (Table 5).

Table 5 "Course Evaluation Questionnaire" results

Course	Students	Range	Mean	St.D
Physical foundations of telecommunications	6	1-5	4.07	0.4
Innovation and Entrepreneurship	5	1-5	4.39	0.26
Physical foundations of the propagation medium, components and devices for telecommunications	7	1-5	4,37	0,31
Economics of technical change	7	1-5	4,31	0,30

All four courses receive high overall score; the difference between the courses is very small.

IV.   Conclusions

This paper reports our experience in embedding performance-centered e-learning in Interdisciplinary Curriculum in Investment Management in Telecommunications. This master program will enrich the students with the technical knowledge, technical thinking and ability to make decisions necessary to be effective manager in the telecommunications business. Our conclusions are:
- The students have very positive attitude towards learning by computer. In general the students demonstrated high positive attitudes towards using electronic learning environments (mean 4.01).
- In the next step of the IMT Programme evaluation, we tested reliability of the DIPSEIL learning platform through Computer System Usability Questionnaire. The results indicated high reliability of the DIPSEIL performance support system (Mean = 5.5; St.D = 0.66).
- The students' answers for the preferred learning environment are optimistic. They show awareness of the need for change and additional work in this aspect. In project-based environment, students have more responsibility for their learning and actions. In such an environment, the teacher becomes a leader, not an information mediator. With the introduction of modern information technologies in universities and greater access to information the opportunities for more project-based activities increase. This reinforces the role of the teacher to shape those students' skills which are necessary throughout their lives and to teach them how to search for information they need.
- The Quality indicators of efficacy in the IMT Master Degree curriculum for the four courses evaluated, show very positive results, with a very good marks received for the different tasks.
- The "Course Evaluation Questionnaire" on the four courses which we put to the students to measure their satisfaction with the IMT curriculum shows a high satisfaction. • Overall, the students liked the interactive activities and the quality of the tasks.

VI.   References

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