



A "Learning Path" towards the Personalized Engineering Education

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Abstract

PiiF, (PiiF stands for "Fluid Engineering Informatics Platform" which in Romanian is: "Platforma Informatica de Ingineria Fluidelor") is a new web-based platform, developed by a consortium of 6 Romanian Technical Universities, aimed to use the collective experience in Fluids Engineering Education. The platform, available on www.piif.ro, has the following pillars:

- *Concepts (more than 900)*
- *Applications (more than 220 simple applications and 183 complex ones)*
- *Books (more than 180)*
- *Animations and movies (more than 300)*
- *Virtual Laboratories (12 on-line test stands)*

This platform represents the collaborative work that, the fluid mechanics, hydraulics or hydraulic machineries departments, of the consortium members, have put together to be used, by students as well as by professors, in the study of fluid engineering. We consider this project to be a good example on both: collaboration in engineering education and new innovative methods for engineering education.

Learning Paths are the most innovative part of the platform, a component using and integrating synergic elements of the other components A learning path can be constructed by any professor /user of the platform by dragging concepts, animations, application or practical work in the virtual laboratories, and putting them into an array suited for an education purpose. It can be a learning path for regular education in fluids engineering, for short term specialization, or in depth study of a specific subject. It is according to our opinion an important tool for a personalized education in engineering.

*„We are born weak, we need strength; helpless, we need aid;
foolish, we need reason.*

*All that we lack at birth, all that we need when we come to man's estate,
is the gift of education.”*

Jean-Jacques Rousseau

It was our starting point that a good engineer relies on a strong engineering education. It was our understanding that we are greatly different as individuals, but that we are actually aiming at similar goals. It was obvious for us that in the today world people wish to access information, and more than that, "specific" information, in a quick way, using the available IT&C resources. We have therefore focused on setting up a web platform to allow students and master students to grab relevant fluid engineering resources in the simplest possible way and to build themselves strong cases against the problems they meet. This is the genesis of the PiiF Project ("Fluid Engineering Informatics Platform Project", www.piif.ro). The Platform supplies various information (part of it interactive), as for instance basic knowledge in fluid engineering with different approaches, applications to be used when confronting specific challenges, movies and simulations, real equipment remotely operated. The student is encouraged to use "bricks" of information, to take the relevant approaches according to his own curricula, and thus to construct his own pool of relevant material and experiments, he can later use for his own personalized educational and research commitments. This means they can chose between how phenomena are described and understood and they are again encouraged to be inductive and creative, even critical, and to share their opinions. It is also about modernization. As in



the contemporary world information is piped through rather unconventional communication, engineering has to be present in the "cloud" of knowledge accessible from any web-connected device. The platform includes a team of teachers supplying the theoretical content for the basic and the complex applications of the Platform (the term "application" will be described below). There is a target group of users, in our case students and master students. Teachers release the information, students and master students collect it. Both groups belong to the main 6 Romanian Universities studying Fluid Mechanics.

One of the constant concerns of nowadays employers is for their new employees not only to have a solid knowledge of basic principles, but also to be able to perform a rational and correct analysis of an uncommon situation, come up with a solution and implement it. Thus, engineering education (not only in the field of fluid engineering) must be approached as such a goal, i.e. to teach students that "basic concepts + correct scientific logic = solving applications". Unfortunately, what we teach students today looks more like a collection of information/recipes that can, apparently, only be applied in some particular situations. Nowadays students lack the exercise of extrapolating the "recipes" or "information" they have learned at the university to slightly different situations and come up with solutions to new problems. The main purpose of the PiiF platform is to try and change this aspect within the Romanian fluid engineering community by teaching students how to apply the correct scientific logic to the basic concepts they have learned, in order to obtain a solution or to solve a problem.

The web based platform that we have built within the PiiF project is organized around this main idea "basic concepts + correct scientific logic = solving applications"

We must emphasize that we are not trying to build up a single standard line of study in fluid engineering. Although all the departments involved in the project basically teach the same discipline, each of them has its own specificity, from emphasis on ship propellers to emphasis on aircraft propellers, from accent on pumps to accent on hydraulic turbines, from highlight on geophysical flows to highlight on urban sanitation systems, from stress on bio-fluid flows to stress on water supply systems etc. The consortium's approach is that we also hope that the web based platform (www.piif.ro) will help widen the engineering horizon of students, who, next to concepts or example scientific and engineering logic in their own line of study, will find other adjacent applications, that use the same basic principles but with the help of different engineering logic are used to solve other problems.

The Platform also provides the teachers with an important tool that helps them build up a modern and appealing course in fluid engineering, regardless of the specificity of each of the partner universities (as long as each of the partner departments will deal with its specific applications, in addition to general concepts).

The platform is opened to teachers that are able to add new concepts or new samples of scientific or engineering logic, new interactive applications or new visualizations or numerical simulations and to all interested students.

Structure of the Platform

The Platform has both hardware support and software facilities.

a. Hardware

There is one main server located into the server room at the project manager's location (Technical University of Civil Engineering Bucharest) and another 6 servers, one for each location, (Technical University of Civil Engineering Bucharest, "Polytechnics" University of Bucharest, "Polytechnics" University Timisoara, Technical University Cluj Napoca, "Dunarea de Jos" University Galati, "Gh. Asachi" Technical University Iasi). Hardware equipment was powered by Dell, www.dell.com.

All servers are running Windows Server 2008 R2 Enterprise. The main server synchronizes all the information with the 6 mirroring servers every 24 hours. On the main server includes 2 load balancing virtual machines; a user logs in into the first virtual machine, the next on the second and so on, "balancing" between the two virtual machines.

b. Software

The PiiF web based platform consists in four databases linked together in order to assess the main



idea of the project, that is: “basic concepts + correct scientific logic = solving applications”.

The four components of the PiiF platform are:

- A database with basic concepts and sample scientific or engineering logic;
- A database with interactive applications for basic concepts and/or scientific logic;
- A virtual database of significant laboratory experiments;
- A database containing flow visualizations and numerical simulations of flow phenomena.

The four databases are linked together so that any teacher will be able to use any of the resources on the platform to build up his own course or to indicate to students a given path through the existing information on the platform. Of course, individual study is also possible. Navigation through the platform can also be performed based on keywords that link different objects in the same data base or different objects from different database.

The interactive applications and the laboratory experiments (“Virtual Laboratories” described below) can be accessed over a Client for RDP/Remote Desktop (<http://www.2x.com/rdp-client>). This allows users to access remote desktops and applications from anywhere and from any web-enabled device, including Android and iOS devices; the remote access is SSL secure and uses the two-factor authentication. Multimedia content is supported via Microsoft RDP7/RemoteFX.

Learning Path

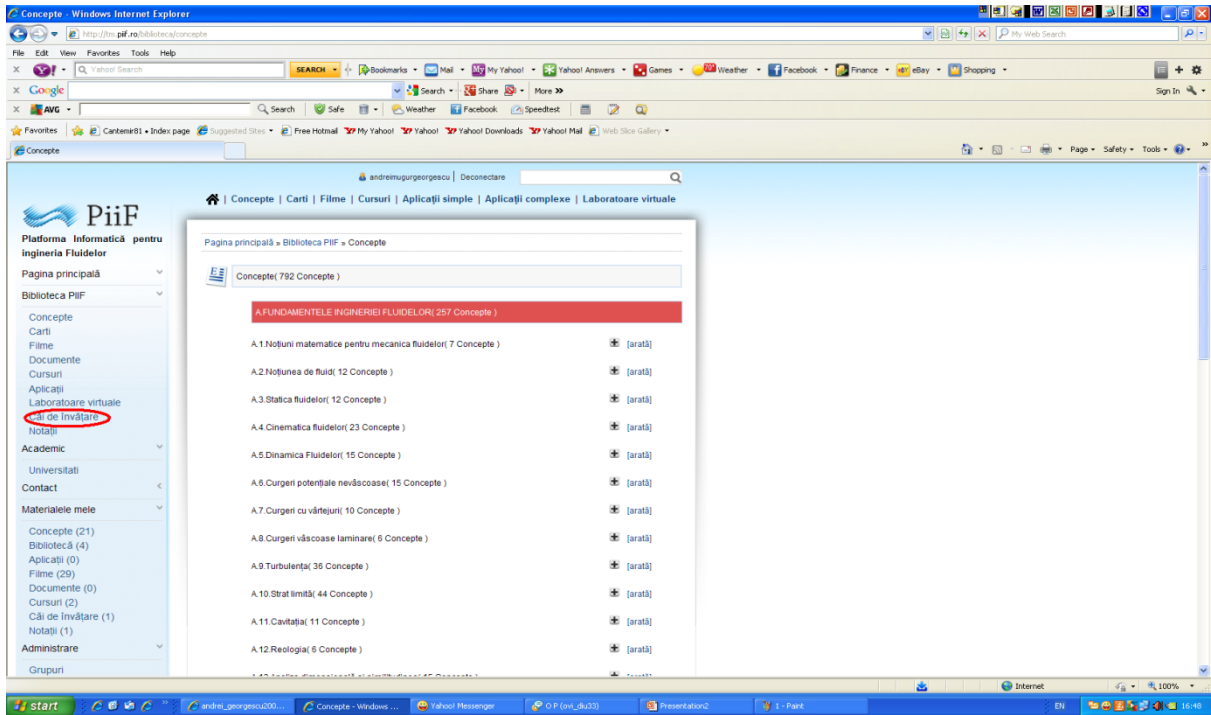
The most advanced feature of the Platform and strongly supporting its main goal, supplying the students with personalized tools for individual educational process, is the “Learning Path”.

A „Learning Path”, as defined in the Platform, represents a sequence of objects, concepts, applications, visualizations, remote operated labs, books), defined by a teacher for his individual students, enabling them to go through a specific fluid engineering curriculum. A Learning Path can only be created by registered teachers.

This advanced modular tool facilitates quick access to virtually any object of the Platform. It is easy to use, based on clicks or drag and drop. It is a tree of information which allows multiple interpretation if the teacher chooses to do so; it is also supposed to guide the students though theory, applications and experiments. Users can follow multiple Learning Paths, by simply selecting them from the available list. Each Learning Path is owned by its author, but other teachers can co-author, too. Its structure is very similar to a tutorial, where you can quickly and easily assemble online content like videos, articles, animations and applications. It is an interactive collection of information, a powerful way to foster interaction between teachers and students.

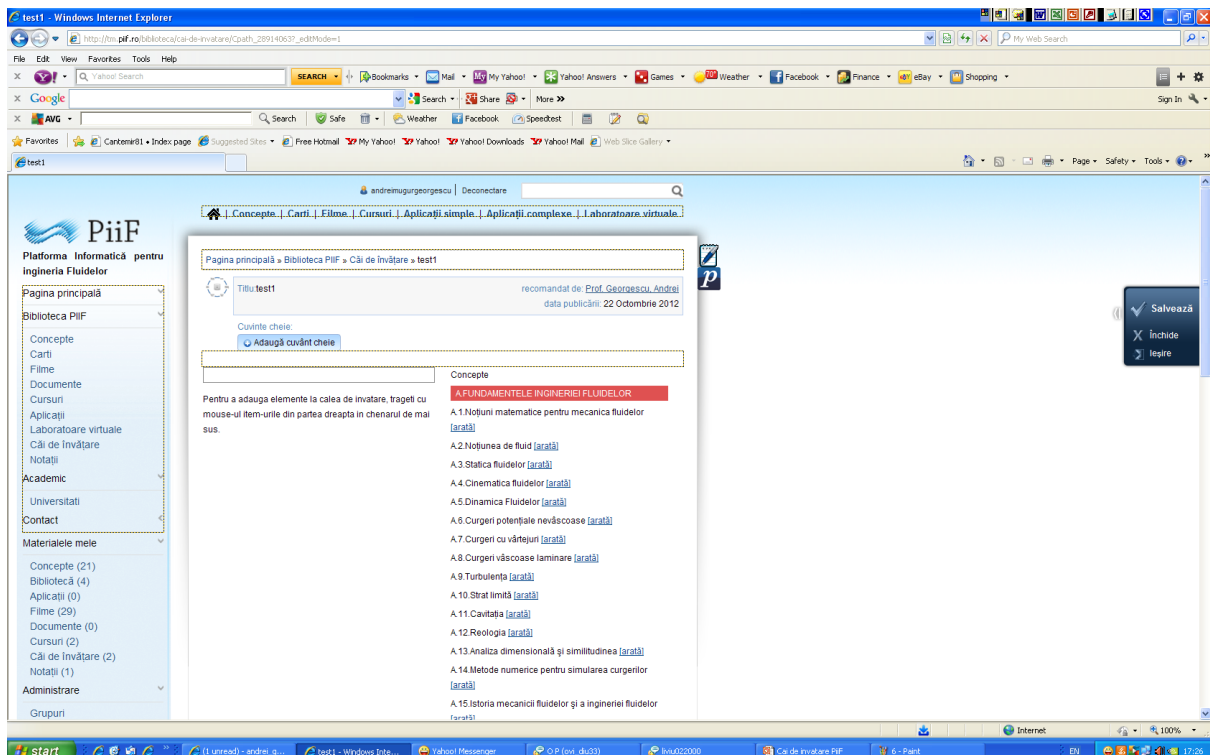
Here is an illustration of how the Learning Path works and how it can be created by a teacher:

1. The teacher will log in the Platform and go to the „Concepts” area and the left menu, „Learning Paths”, becomes available. Click on it. The existing Learning Paths will be shown in a dropdown list, as pictured below. To view an existing Learning Path, click on it.

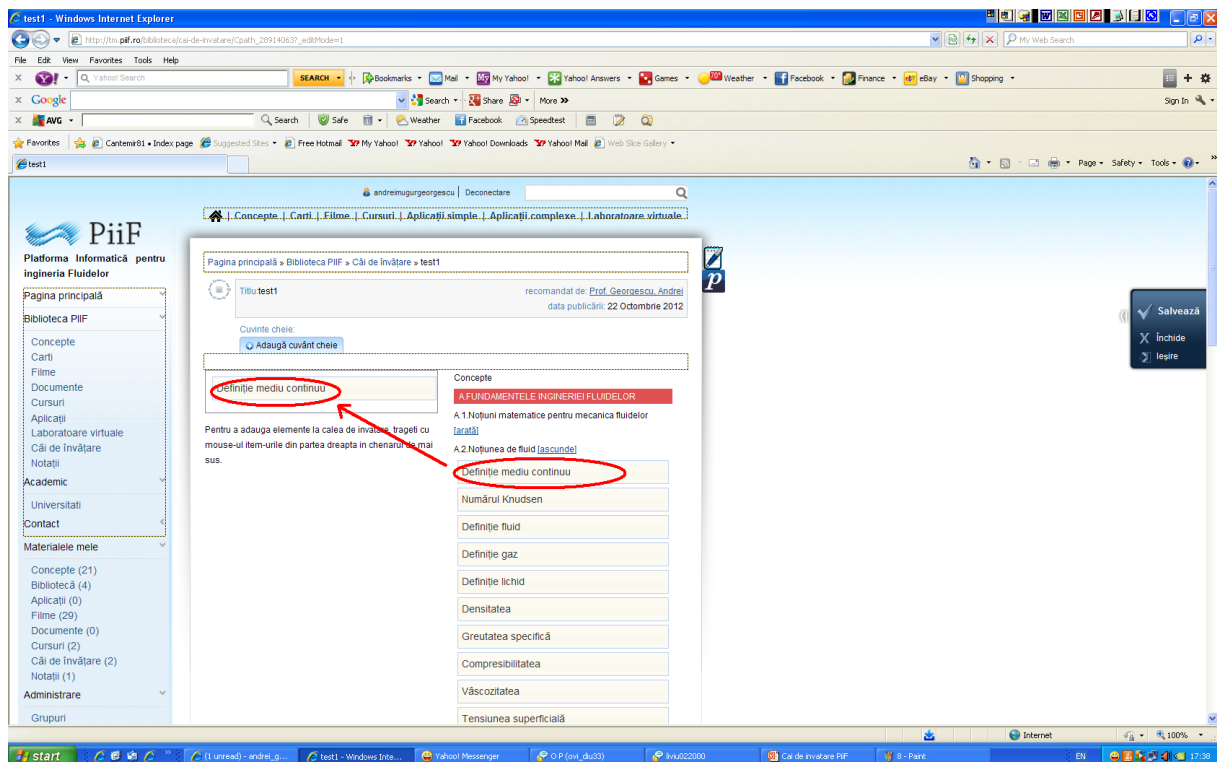


2. To create a new Learning Path click on the „+” sign, on the top right, this will open a new window. Input the title of the new Learning Path. Upload an existing brief description, if any, then click „ok”. A window opens, input the title of the new Learning Path, upload an existing brief description, if any, then click “ok”.

3. The new Learning Path has been created and is ready to be filled in with relevant information. A two column window will open: the left column shows the Learning Path itself, the right column shows the existing objects on the Platform.



4. Just drag and drop the concepts, applications, animations etc into the Learning Path as shown below



5. Any of the existing objects of the Platform can be linked to a Learning Path. They can also be organized within the Learning Path according to teacher's logic. To delete an object from the Learning Path, click on the „X” button next to the object. After completing the Learning Path, click “Save” and “Close” the „Edit” session.

Concluding Remarks

Through the PiiF platform, we have created a new and both modern and original educational tool which is far more competitive than the conservative rote learning and memorization.

Our system is more flexible than most of the available solutions in the educational market and one of the most complex ones. The goal we have attempted and reached was to provide personalized and systematic knowledge to each and every student.

We are very much aware that it's a long road to an individualized education, but now we can catch a glimpse of it.