Deliverable number	3.2		
Title	Two educational programmes on microreactor technology		
Type of outputs / products / results	New curricula on MRT		
Delivery date	September 2013	**Dissemination level**	☒ Public ☐ Restricted to other programme participants (including Commission services and project reviewers) ☐ Confidential, only for members of the consortium (including EACEA and Commission services and project reviewers)
Nature	☐ Report ☒ Service / Product ☐ Demonstrator / Prototype ☐ Event ☐ Other		
Language versions	EN		
Target languages			
Description (limit 1000 characters)			
An educational programme on microreactor technology, will be developed by both Zuyd and Provadis. The programme will consist of lectures and trainings in practical skills, available for students and adult learners. This workshop will make use of the online educational content and online communication function of the NIL. Students will be encouraged to use the NIL to enrich their learning of MRT.			

Summary

The material developed in this project is used as part of a research minor of Zuyd university (30 EC) and in an exchange program between Provadis (PSIMT) and Zuyd (D3.2 Two educational programmes on microreactor technology).

On the website of the project (knowledge base) there are several e-modules, including three (instead of two!) educational programmes: Learning route beginner, advanced and commercial.

A research minor includes a tailor made teaching programme designed by the student and the coach. Besides the use of e-learning modules and attending a master class this includes a literature survey, courses or interviews with professionals. The research minors make use of the platform developed in WP2 and serve as evaluation instruments and redesign. At the partner institutes projects are performed in a similar way. In a yearly exchange programme,

Provadis and ZUYD students (10-20 in total) work together on a MRT project, first at Provadis in Frankfurt (D) and then at ZUYD in Heerlen (NL).
Furthermore parts of the material will be used in a synthesis project of year 2 at Zuyd (Flavonoid project) and for lab classes within a catalysis module at Provadis. The students enrolled in specific modules (06746/48/49) of University of Hull (UHull) and the post-graduate students researching in the field of microfluidics will be directed to subscribe and exploit the developed website as a means for researching basic information on microreactor technology and lab on a chip. At Dublin City University (DCU) the site will be primarily be used by the research groups.

General Introduction

It is important to teach students new technologies. Often these technologies are based on basic principles which are already part of the curricula of universities. More and more, however, the basic knowledge and skills needed for new technologies are part of different traditional domains. Furthermore, new combinations of traditional skill are needed to comprehend and apply these technologies. This means that traditional teaching i.e. teaching all skills and knowledge needed for a certain field is not possible anymore. Learning is becoming more tailor made and the engineers of the future have to be able to pick up new technologies and collaborate and interact with other disciplines.

Zuyd University

Professional Bachelors in the chemistry domain will mainly start their professional carrier as lab technicians and engineers i.e. they mainly apply (a broad range of) technologies. Being a University of Applied Sciences, the main goal of the research performed at Zuyd is transferring academic knowledge to industries.
Currently there are 3 chemistry (related) Studies: Biology and Medical Lab Research (BML), Chemistry (Analytical and Synthetic) and Chemical Engineering (Material Sciences and Process Technology).
The first year, these 3 studies have a common program with as main goals learning the basics of chemistry and orientation on the 3 different studies. In year 2 a part of the program is common but there is also room for specification to one of the studies. In projects students work from their discipline on a common subject.
Year 3 and 4 the 3 studies are completely separated and follow their own, more specific, program. Year 3 starts with an internship at a company or institute (30 EC). Next students follow theory (30 EC for BML and CH, 60 for CE) and a research minor (respectively 30 and 15 EC). They finish their study with an internship (BML, CH: 45 EC; CE: 30 ECs). Next year, the three studies will merge to one “broad” bachelor program (Applied Science) in which students can individually define a route to a more specialized professional are a broader orientated professional.

MRT at Zuyd

Microreactor technology has most impact on the synthetic chemist and process engineers. In the first year of their study, the basics of chemistry have a focus and there is no specific focus on MRT other than preferably using examples from the focus technologies of Zuyd (**MRT**, nanotechnology, materials for 3D printing and molecular diagnostics). In the second part of year 2 students are involved in a project about flavonoids. Flavonoids are naturally occurring anti-oxidants with beneficial health effects. In this project, the chemist prepare and modify flavonoids comparing **MRT** with batch procedures. Next, the process engineers design a scale up procedure and the medical lab researchers asses the flavonoids in terms of anti-oxidant capacity.
Since **MRT** is a research spearhead at Zuyd, students can follow a research minor in **MRT**. This research minor focusses on a **MRT** related assignment from a company. The research team (Community for Development - CfD) consists of a coach, experienced researcher and starting professionals (students). Depending on the exact research question and the background of the starting professionals a tailor made teaching program is designed. Besides the

use of e-learning modules and attending a master class this includes a literature survey, courses or interviews with professionals.
The results of these case studies are presented on the website and could be used as framework for (educational) projects.
Because of the huge network of companies involved in **MRT** internships at companies of institutes (e.g. the partners involved in this project) is possible.
For students interested in **MRT** and open for exchange with other students, 2nd and 3rd year students can enroll in an extracurricular exchange program with Provadis University. In this yearly program, mixed groups of students work together on a MRT project, making use of the tools developed.

Provadis

Because Provadis is also a University of Applied Sciences, a similar program is followed as at Zuyd. Since it is a private university located at a chemical site there is no Medical Research profile and the focus is more towards production (i.e. engineering). Details of the program and exact organization structure are of course also somewhat different (see attachment). Since the developed tools are modular, however, implementation is not dependent on exact structure and focus. As an example, at Provadis, the starting level case studies are used in an integrated theory/labclass module about catalysis. As with Zuyd University, the tools are used in research projects (e.g. for their master thesis).

Dublin City University and University of Hull

Research oriented universities, such as DCU and UHull have a multitude of specialized, specific research groups and students are quite mobile. Research is more dedicated to develop new technologies and methodologies rather than application of these technologies. But also in the academic world there is a need for access to knowledge and skills of different disciplines.
Again, the tools developed in this project can easily be implemented in the education and research programs of academics. For example, students enrolled in specific modules (06746/48/49) of UHull and the post-graduate students researching in the field of microfluidics will be directed to subscribe and exploit the developed website as a means for researching basic information on microreactor technology and lab on a chip. At DCU the site will be primarily used by the research groups.

Conclusion

The tools developed in this project can be used to design a MRT program which fits the occasion and meets the needs of modern learning.
Based on these tools, both Zuyd and Provadis designed a MRT program which fits in the curricula and vision of the respective universities. DCU and UHull started the use of the network and their content in their more specific research programs.