Higher Education Reform Project

SEMINAR FOR BOLOGNA AND HIGHER EDUCATION REFORM EXPERTS:

Research-based Education: Strategy and Implementation.

READER

Eötvös Loránd University (ELTE)
Budapest

5-7 November 2012

Lifelong Learning

Tempus

UNICA
Network of Universities from the Capitals of Europe

Brussels Education Services

This event has been funded by the European Commission DG EAC through the Lifelong Learning Programme and within the framework of the European Union Tempus programme which is funded by the Directorate General for Development and Co-operation - EuropeAid and the Directorate General for Enlargement.

CONTENT

This project has been funded with support from the European Commission. This publication reflects the views only of the author(s), and the Commission cannot be held responsible for any use which may be made of the information contained therein.

CHAPTER 1: MESSAGES FROM THE ORGANISERS

1.1. Welcome to Budapest

Dear Colleagues,

It is a great pleasure and honour for us to welcome you to the seminar for Bologna and Higher Education reform experts „Research-based Education: Strategy and Implementation'" on November 5-7, 2012, under the Higher Education Reform project funded by the European Commission. The seminar is co-organized by the European Commission, UNICA Network, Brussels Education Services and Eötvös Loránd University, Budapest, hosting the event.

We are glad to welcome you in Hungary, a new and active member of the European Union (since May 1, 2004). This small country boasting over 1000 years of statehood tradition is situated in the middle of the continent, in Central Europe. This is a country

- where 2000-year-old Roman ruins, 400-year-old Turkish monuments stand side by side with Baroque and classical buildings and 21st century glass office blocks.
- which boasts the largest thermal water cave system and the second largest thermal lake in the world (Lake Hévíz), the largest lake in Central Europe (Balaton) and the largest natural grasslands in Europe (Hortobágy), which provide natural paradise for visitors
- where hundreds of therapeutic mineral springs gush up from the depths
- where people speak a language and form a culture unlike any other in the region; this distinctiveness has been both a source of pride and an obstacle for more than 1100 years.

And what are the people like? When Nobel Prize winner Enrico Fermi was asked if he believed in extraterrestrials, he replied: "*They are among us, but they call themselves Hungarians*"

Budapest – often called the "Pearl of the Danube"– is the largest city and the capital of Hungary. It is situated in the heart of the country and divided by the river Danube creating the hilly Buda and the flat Pest side. Its territory is more than 500 km^2, with a population of 1.8 million in 23 districts. Our largest city takes pride in the banks of the Danube, the Buda Castle Quarter, Andrássy Avenue, Heroes' Square and the Millennium Underground Railway, which are among the UNESCO World Heritage Sites. In addition, Budapest is abundant with other sights attracting many tourists, like the Citadel, the Parliament, Margaret Island, Váci Street, St. Stephen's Basilica and several thermal baths. The city also provides various programmes for its visitors all over the year. Spring and Sziget Festivals are the most popular ones, but one could also mention traditional fairs, exhibitions, classical music concerts etc.

Eötvös Loránd University (ELTE), which welcomes you now, is an integral part of the city and the country. Presidents and Prime Ministers, ministers and high officials of all countries coming to Budapest also visit our University. Being the oldest and leading research university in Hungary, it serves the interests of high quality education and cutting edge research with the conviction that neither can exist without the other. Therefore, all our educational programmes implement the latest research achievements. Besides, ELTE is one of the most internationalized institutions in Hungary with more than 700 European and more than 50 partner universities from other continents. To ELTE, profiting from such an international environment means to design the highest academic standard educational programmes, with the most of our educational and industrial partners. This philosophy of co-operation assures that the degrees issued here are accepted all over the globe and ELTE graduates are on steady demand on the labour market, which is why it enjoys the greatest popularity among Hungarian school leavers. In the field of

scientific and research activities ELTE successfully joins European Union programmes. Since its foundation, it has significantly contributed to the development as well as the enrichment and utilisation of scientific knowledge for the benefit of mankind.

The Bologna and Higher Education expert seminar is a great occasion for our University to contribute to the future of EHEA and broaden cooperation perspectives. The organizing team welcomes you at ELTE and wishes you nice stay, great experience, and fruitful work.

Local organizing team

1.2. The Budapest Bologna Café

Dear Experts

On the occasion of the upcoming seminar in Budapest, we are planning to test a new format offering opportunities for peer learning and expert discussions.

On Tuesday 6 November between 15.30 and 17.00 the seminar participants will be welcomed in the Budapest Bologna Café. Coffee, tea and little snacks will be available and the venue will hold a total of about 15 tables with up to 10 seats each.

The idea is for each table to be 'hosted' by a volunteer Bologna or Tempus Higher Education Reform Expert who is eager to trigger off a discussion on a burning issue related with Higher Education Reform in general or, else, focussing on the role of the Experts in their home countries. The host will launch and monitor the discussion among the participants who have shown up at the table. As you will have understood, with the Café we are opting for a rather informal setting in which everybody is offered the opportunity to talk. No elaborate presentations will be expected, but you may wish to bring a short hand-out. There will two sessions that will not last longer than 30 - 40 minutes so that all participants can follow two different discussions of their choice.

We are currently looking for volunteer experts who are ready to host one of the tables. We would like to ask you kindly to send in your suggestions for topics to conference@unica-network.eu at the latest by Tuesday 30 October. By the time the seminar takes place, we will have a programme ready clearly indicating the numbers of the tables, the corresponding topics of discussion and the respective hosts. Further practical information on the organisation of the Budapest Bologna Café will be shared with the participants in Budapest.

We are looking forward to receiving your proposals and hope we will be able to accommodate all of you who are eager to engage!

Best wishes from Brussels

On behalf of the UNICA – Brussels Education Services Consortium

1.3. Speakers' short biographies

Andrea Nolan is Professor, Senior Vice-Principal, University of Glasgow and Chair of SHEEC (Scottish Higher Education Enhancement Committee)

Andrea Nolan graduated as a veterinary surgeon from Trinity College Dublin, Ireland and after a short time in veterinary practice, embarked on an academic career which took her to the Universities of Cambridge, Bristol and the Technical University, Munich, leading to her appointment as a Lecturer at the University of Glasgow in 1989 where she established herself as a researcher in the field of animal pain. She was appointed Professor of Veterinary Pharmacology in 1998 and took up the post of Dean of the Faculty of Veterinary Medicine a year later. She was appointed Vice Principal for Learning & Teaching in the University of Glasgow in 2004, and in 2009 was appointed to the position of Senior Vice-Principal & Deputy Vice Chancellor. She is a Fellow of the Royal Society of Edinburgh.

Andrea has been a member of the Scottish Higher Education Enhancement Committee (SHEEC) since 2006, during which time she chaired the national enhancement theme 'Research Teaching Linkages: enhancing graduate attributes', and over the last three years, she has been its Chair.

Mick Healey is a HE Consultant and Researcher and Emeritus Professor at the University of Gloucestershire, UK. Until 2010 he was Director of the Centre for Active Learning, a nationally funded Centre for Excellence in Teaching and Learning at the University of Gloucestershire, UK. He is an Honorary Professor at the University of Queensland, an adjunct professor at Macquarie University and a visiting professor at University of Wales, Newport. He was one of the first people in the UK to be awarded a National Teaching Fellowship and to be made a Senior Fellow of the Higher Education Academy. Mick is an experienced presenter. Since 1995 he has given over 450 educational workshops, seminars and conference presentations, including at Amsterdam, Copenhagen, Cork, Iceland, Leiden, Southern Denmark, Stockholm, Tilburg, Trinity College Dublin, Utrecht and Vienna. He has written and edited over 150 papers, chapters, books and guides on various aspects of teaching and learning in higher education. He is often asked to act as an advisor to projects, universities and national governments on aspects of teaching and learning in HE. For example, he has advised the Australian Learning and Teaching Council, the Canadian Federal government, the Higher Education Authority for Ireland, the Higher Education Academy in the UK, and the League of European Research Universities on research based teaching and learning. He is the international co-editor for the *Council on Undergraduate Resesarch Quarterly.*

Selected recent references on topic of the workshop:

A full list of references may be found at www.mickhealey.co.uk

2005 Linking research and teaching exploring disciplinary spaces and the role of inquiry-based learning, in Barnett, R (ed) *Reshaping the university: new relationships between research, scholarship and teaching* McGraw-Hill/Open University Press, 67-78

2007 *Linking teaching and research in departments and disciplines* York: The Higher Education Academy (Jenkins A, Healey M and Zetter R) 96pp (ISBN 978-1-905788-38-5) http://www.heacademy.ac.uk/ourwork/research/teaching

2009 *Developing undergraduate research and inquiry*. York: HE Academy (Healey M and Jenkins A) 152pp (ISBN 978 1 905788 99 6) http://www.heacademy.ac.uk/assets/York/documents/resources/publications/DevelopingUndergraduate_Final.pdf

2012 Developing and embedding inquiry-guided learning across an institution, in Lee V S (ed) *Inquiry-guided learning. New Directions for Teaching and Learning*, 129. San Francisco, CA: Jossey-Bass. (Jenkins M and Healey M) pp27-37
2013 Collaborative discipline-based curriculum change: applying *Change Academy* processes at department level, *International Journal for Academic Development* 18(1) (Healey M, Bradford M, Roberts C and Yolande K) published on i-First Dec 2011

Ellen Bastiaens is the program manager for three programs on educational innovation at Maastricht University, where she works in the Maastricht University Office, the central policy department.

In the first program she works closely together with professor Wim Gijselaers. In 2010 the program Leading in Learning was initiated to give a boost to the improvement and innovation of the problem based learning model.
In the other two programs she is program manager of excellence programs; - The Maastricht Research Based Learning program (MaRBLe) is an excellence program for third year bachelor students at all faculties and focuses on research based learning as an educational model; - The PREMIUM program is about the implementation of an excellence model for master students and focuses on multidisciplinary teams working on an authentic assignment by authentic clients. For these programs she coordinates a team of highly motivated staff members responsible for the actual implementation of the programs at the faculties.

After studying educational technology at the University of Twente, she received her PhD in 1998 on a study into standardization of processes for curriculum development. She then worked for 10 years at Statistics Netherlands in various functions, amongst others as a head of the educational department.

Wolfgang Deicke (email: wolfgang.deicke@hu-berlin.de)
Prior to becoming the co-ordinator of the bologna.lab at Humboldt University, Wolfgang gathered extensive experience in teaching and course development at the (now) University of Northampton (1994-2003), the School of Oriental and African Studies, London (2003-2005) and Ruskin College, Oxford (2005-2011). A social scientist by background, he developed an interest in curriculum design and the development of teaching and learning strategies in different institutional settings and for different groups of learners.

Christopher Gess (email: christopher.gess@hu-berlin.de)
Christopher is an evaluation expert and responsible for the implementation of new evaluation concepts for the research-based education projects at Humboldt University. He holds a teaching degree from Bielefeld University (Germany) and a Master of Public Administration from Columbia University (US). Before joining the bologna.lab, Christopher worked for an international policy consultancy and managed several evaluation projects in family policy, education and development. His clients included federal ministries, national foundations and municipalities. Christopher currently focuses on tracing and measuring research competence.

Julia Rueß (email: julia.ruess@hu-berlin.de)
Julia is the bologna.lab's expert for the development and promotion of new teaching-learning formats at Humboldt University. She holds a degree in Social and Communication Science, specializing in empirical social research. Prior to joining the bologna.lab, Julia worked on several evaluation projects in educational policy on Federal and State Level, focusing on higher education as well as on the transition from school to university. Her main research interest lies in the effects of research-based education, especially changes in epistemological beliefs.

Endika Bengoetxea has a BSc in Computer Science from the universities of the Basque Country (ES) and Brighton (England), an MSc in medical imaging from the University of Aberdeen (Scotland), and a PhD in Image and Signal Processing from Télécom Paris in France.

Currently, Dr. Bengoetxea holds the position of Senior Education Officer at the EIT since April 2012, and he is leader of the team in charge of the education, entrepreneurship and innovation agendas in collaboration with EIT's KICs (Knowledge Innovation Communities). Previously he worked three years in DG Education and Culture as higher education policy officer and Erasmus programme manager, as responsible for the coordination of Erasmus centralised actions and the EACEA, the Erasmus University Charter, Erasmus Country Desk Officer for the UK, and in policy works notably on third cycle policy, quality assurance and transparency tools. Before joining the European Commission, he worked from 1996 to 2009 as professor at the University of the Basque Country in Spain.

Being a former Erasmus student in 1993/94 in the UK, Dr. Bengoetxea had several management positions in the University of the Basque Country related to international relations. From 2001 to 2009 he has also been independent academic expert in DG EAC and DG INFSO programmes such as Leonardo, Erasmus, Tempus, Erasmus Mundus, FP6 and FP7.

1.4. László Mérö, research psychologist and popular science author.

He is professor of economic psychology at Loránd Eötvös University, Budapest. He runs classes on Economic psychology, Game theory, Human thought and decision, Methodology, Mathematical statistics, etc.

In 1968, he took part in the 10th International Mathematical Olyampiade in Moscow, and won a bronze medal. He graduated in mathematics, and spent 10 years as a research fellow at an academic research institute, taking part in various artificial intelligence projects.

From 1984 to 2005, he was associate professor at the Department of Experimental Psychology of Loránd Eötvös University. His research areas were psychophysics, than human thought strategies, game theory, and recently, economic psychology.

Between 1996 and 2001 he worked with Ernő Rubik, inventor of the Rubik's Cube, on computer game software developments, including the successful video game *Rubik's Games.*

He has published a few books for a wide intellectual readership, they have been published alltogether in 8 languages (in English: *Ways of thinking*, World Scientific, 1990; *Moral calculations*, Springer, 1998; *The logic of emotions*, to be published in 2013). The German edition of the book *Moral calculations* has won an award „The science book of the year 1998 in Germany".

CHAPTER 2: THE BOLOGNA FOLLOW UP GROUP WORK PLAN 2012 – 2015

Please note that the text below is an abstract. The full document can be downloaded from the Budapest Seminar website: http://budapest2012.bolognaexperts.net

BFUG Work Plan 2012-2015

Introduction

The 2012-2015 BFUG work plan is aimed at reflecting the main follow-up activities in line with the priorities set by the European Higher Education Area (EHEA) Ministers via the Bucharest Ministerial Communiqué. The present document was discussed for the first time in the BFUG Board meeting on 31 May 2012 in Sarajevo. The draft work plan with the integrated comments received from the BFUG members, the European Commission and the consultative members was discussed and adopted during the Nicosia BFUG meeting on 28-29 August 2012 by the Bologna Follow-Up Group (BFUG).

The present structure of the BFUG work plan is based on the three main political goals outlined by the Bucharest Communiqué (quality higher education for all, enhancing graduates' employability and strengthening mobility as means for better learning) and the main priorities for action at the European level included in the final section of the Bucharest Communiqué. Based on the need to focus on full and proper implementation of the main action lines of the Bologna Process, the work plan makes an attempt to streamline the activity of the BFUG, as well as that of its sub-structures, in order to increase the overall transparency and effectiveness of the BFUG.

The basis for the proposal lies within the need to respond to three main questions, namely:

1. What are the major challenges according to the EHEA status-quo and the Bucharest ministerial commitments?
2. How to organise the follow-up work efficiently with more foci on the implementation and oriented to meeting the Bucharest commitments?
3. How should the EHEA interact with other areas of the world and what are the main topics of interest for future policy dialogues?

Proposal for the structure underpinning the 2012-2015 BFUG work plan

The BFUG Board proposed in its Sarajevo meeting (31 May 2012) that four main working groups are set up, bringing together the main priorities for action under each of the Bucharest Communiqué political goals:

⇒ WG on reporting on the Bologna Process implementation,

⇒ WG on qualifications frameworks, recognition, quality assurance and transparency ('Structural' WG),

⇒ WG on the social dimension and lifelong learning,

⇒ WG on mobility and internationalisation.

Each of the above mentioned Working Groups would have the authority to set-up ad-hoc working groups and networks which are subject to the approval of the BFUG. Each Working Group will be encouraged to use a variety of working methods that will include organisation of seminars from which policy recommendations would be collected, analysed and synthesised for the BFUG discussions. The seminars will ensure the visibility of the Bologna Process and its policy areas. The new structure is aimed to achieve more coherence and comprehensiveness in formulating policies and implementation recommendations for the BFUG to be discussed and endorsed prior to the 2015 Ministerial Conference.

In terms of advancing the EHEA consolidation and promotion of the progress of implementation of the Bologna reforms at both national and institutional levels, the BFUG Board will make recommendations regarding the main tasks for the period of 2012-2015 for a voluntary peer learning and peer review system in the Bologna Process which will be further discussed and endorsed by the BFUG in Dublin on March 14-15, 2013. It is important that all the four Working Groups take the responsibility for the initiative and provide input in its development. In terms of the sustainability of this initiative, support could be envisaged from the upcoming EU 'Erasmus for All' budget and national sources, but before that, other possible sources could be identified in the existing EU financial framework, such as the programmes associated with the Eastern Partnership etc.

The main types of BFUG sub-structures used in this work plan are:

Working groups:

- This a generic term used for all the groups established by the BFUG in order to fulfil a complex task within the 2012-2015 Work Plan. The specific nature and the precise tasks of each group are outlined in the respective Terms of Reference.
- They are open to participation from all the Bologna countries, the European Commission and the Consultative members.
- Composition should reflect the diversity of the EHEA. Where necessary, the groups can also decide to set-up ad hoc working groups and networks, which can involve external experts.
- Working Groups are the main BFUG structures which can make policy recommendations, based on their Terms of Reference and the results of the ad-hoc working groups and networks under their direct coordination.
- Working Groups are coordinated by two or more co-chairs. All the chairs should be the, BFUG members. In case of more than, two chairs a steering committee is formed with a main facilitator. One representative of the Co-Chairing team should attend the BFUG Board meetings, in order to ensure the coherence of the communication and of the documents discussed by the BFUG.
- Working Groups should report back to the BFUG. **The final reports / conclusions and policy recommendations for the 2012-2015 period should be presented and discussed no later**

than the BFUG meeting in the Fall of 2014 and only in case of the WG on the Reporting of the Bologna Process Implementation the deadline should be extended to January-February, 2015.

Ad-hoc working groups:

- These are not permanent structures, but smaller working groups to be established by the BFUG main four Working Groups or by the BFUG/ BFUG Board in order to fulfil a specific task within a limited timeframe dependent on the task at hand (shorter than the three-year period).
- They can develop policy recommendations to be submitted to their coordinating structure (either the BFUG or a Working Group).
- Their composition should reflect the task at hand and be chaired by a BFUG member.

Networks:

- They should be established by the BFUG working groups or by the BFUG/ BFUG Board and for a longer term cooperation between a large number of partners (potentially all the EHEA countries and organisations).
- In terms of activity, these networks connect experts in a specific field (e.g. student support, recognition of prior learning or qualifications frameworks) from the different EHEA countries and organisations and allow them to share information and examples of good practice, to assist each other, and possibly also to develop new policies, if this is clearly outlined in the Terms of Reference.
- They are not expected to issue policy recommendations unless stated in the Terms of Reference;
- Should be connected to a specific Working Group and include at least a BFUG member (preferably also one of the Co-Chairs of the 'parent' WG) in the meetings, if only composed of national experts, in order to allow for good communication with the BFUG as a whole.

Seminars/Conferences:

- The EHEA has an open calendar of events, situated on the home page of the EHEA permanent website (www.ehea.info).
- The EHEA members and consultative members are encouraged to arrange seminars, conferences and workshops along the priorities set by the Bucharest Communiqué.
- For an event to be included in the calendar of events that is published on the official EHEA website, it obviously has to be related to the Bologna Process and should be organised or at least supported by one of the countries/ organisations participating in the Bologna Process or by a BFUG WG. Moreover, it should in principle be open to participants from all Bologna countries, which however does not exclude international events that have a more regional focus.
- Invitations, presentations, reports and conclusions can be published on the website and forwarded to the BFUG upon request of the organisers.

CHAPTER 3: RESEARCH BASED EDUCATION: STRATEGY AND IMPLEMENTATION – SELECTION OF ARTICLES

3.1. Does Faculty Research Improve Undergraduate Teaching? An Analysis of Existing and Potential Synergies

MICHAEL J. PRINCE, ***Department of Chemical Engineering, Bucknell University***
RICHARD M. FELDER, ***Department of Chemical Engineering, North Carolina State University***
REBECCA BRENT, ***Education Designs, Inc.***

'…II. BRINGING RESEARCH INTO THE CLASSROOM

Probably the most conventional argument for how research supports teaching is that faculty with active research programs bring their research into the classroom and use it to inform their teaching.

Pocklington and Tupper [27] found that this assumption is frequently unjustified and claim that "current models of integration are inadequate philosophically, they are naïve politically; and they ignore reforms essential to integrating research and teaching." Colbeck [26] observes that it is difficult to bring research into the classroom in "hard" disciplines such as the physical sciences and engineering for two reasons: hierarchical knowledge structures in those disciplines put most research well over the heads of most undergraduates, and rigidly constrained curricula limit opportunities to bring in new material.

The few published claims we could find regarding the benefits of incorporating research in undergraduate classes rely on indirect measures such as self-reports, and show mixed results. Jenkins et al. [28] used data from student focus groups to argue that integrating research can benefit students through "staff enthusiasm, credibility and institutional reputation," and Neumann [29] reported students' opinions that integrating research helped instructors impart a positive and inquisitive approach to learning. Both articles also note, however, that some students they interviewed saw negative effects of research integration, such as inappropriately skewing the focus of courses or detracting from the instructors' interest in or time for undergraduate teaching. The implication is that integrating research into undergraduate courses *may* be beneficial provided that the research illuminates essential course content without distracting from it or confusing more than it clarifies, but at this point the argument that bringing research into the classroom has improved teaching in practice has yet to be demonstrated by the relevant scholarship.

While there is presently little data to support the conventional argument that faculty effectively integrate the *content* of their research into their classes, faculty might link their research and teaching more effectively by introducing students in their classes to the research *process*. A faculty member's research provides experiences that have the potential to enrich instruction by introducing students to the research process and to important research skills. What researchers do routinely is confront open-ended and imperfectly defined problems, figure out what they need to know and how to find it out; search out sources of missing information; hypothesize and test possible solutions; arrive at final results; and defend them. The traditional lecture-based teaching model, in which instructors present perfectly organized derivations and examples on the board or in PowerPoint(tm) slides, and then ask students to reproduce and/or apply the information in assignments and tests, bears little resemblance to the research process.

An instructional strategy that comes much closer to emulating research is *inductive teaching.* In this approach, the students are first presented with a challenge of some sort—a question to be answered, a problem to be solved, or a set of observations or experimental results to be explained—and learning takes place in the context of the students' attempting to meet the challenge. Variations of this approach include inquiry-based learning, problem-based learning, and project based learning. Prince and Felder [30, 31] compare and contrast different inductive methods, summarize the research that attests to their effectiveness, and provide guidance in identifying and applying the method best suited for a particular course and instructor.

It is certainly reasonable to hypothesize that faculty could capitalize on their research experience in the classroom using inductive methods. For example, skilled faculty researchers could take the methods they use in their scholarly activities and translate them into an inductive teaching environment by borrowing elements of their own research or choosing challenges more appropriate to the subjects and levels of the courses they are teaching. The faculty's research knowledge and experience, including their knowledge of the relevant literature, familiarity with current information finding strategies, knowledge of modern laboratory techniques, experience supervising research students, awareness of colleagues doing related work in the field or simply their intimate familiarity with the research process itself, could all be brought into their teaching and thereby enrich student instruction in this classroom environment. Students taught in this manner would get excellent training in the skills required for graduate study and research careers. More importantly, it would help students to develop critical thinking and problem-solving skills that will serve them well in any career path they undertake. In addition, if students are taught inductively as freshmen and sophomores, it could induce many of them to seek research experiences later in the curriculum, the educational benefits of which are discussed in the next section of this paper.

Others have similarly called on universities to capitalize on their research activity for educational purposes in this way. Beginning in 1995, a major study of education at research universities was carried out by a distinguished group of scholars under the sponsorship of the Carnegie Foundation for the Advancement of Teaching. The group (later called the Boyer Commission to honor Ernest L. Boyer, the president of the Foundation who initiated the study) proposed that research universities should make the research-teaching nexus central to their instructional mission and offered persuasive evidence that they have seriously failed to do so. The final Boyer Commission report had as one of its primary recommendations that research institutions should move to an inquiry-based approach to teaching.

The experience of most undergraduates at most research universities is that of receiving what is served out to them. In one course after another they listen, transcribe, absorb, and repeat, essentially as undergraduates have done for centuries. The ideal embodied in this report would turn the prevailing undergraduate culture of receivers into a culture of inquirers, a culture in which faculty, graduate students, and undergraduates share an adventure of discovery. In a setting in which inquiry is prized, every course in an undergraduate curriculum should provide an opportunity for a student to succeed through discovery-based methods [23, pp. 16–17]. As the Boyer Commission envisioned it, repeated exposure to inductive teaching throughout the curriculum would equip students to function effectively as researchers by the time they graduate.

As undergraduates advance through a program, their learning experiences should become closer and closer to the activity of the graduate student. By the senior year, the able undergraduate should be ready for research of the same character and approximately the same complexity as the first-year graduate student; the research university needs to make that zone of transition from senior to graduate student easy to enter and easy to cross. For those who do not enter graduate school, the abilities to identify, analyze, and resolve problems will prove invaluable in

professional life and in citizenship [23, p. 17]. Additional authors have issued similar calls for a change in the dominant mode of undergraduate instruction, in part as a way to strengthen the connection between teaching and research. Badley [32] proposes that research and teaching might both be envisioned as forms of inquiry if one gets away from the traditional model of teaching as transmitting information and turns instead to any of several inductive teaching approaches. Elton [33] and Brew [34] similarly conclude that a positive research-teaching link depends primarily on the nature of the students' learning experiences and also propose that student-centered teaching (as exemplified by inductive approaches) provides the type of experience that enhances the connection.

In summary, integrating research into the classroom in the way integration is normally conceived—i.e., instructors discussing the content of their research—has not been shown to occur frequently or to improve learning. An alternative way to integrate research into the classroom, and one with much more empirical support in terms of improving students' learning, is to teach in a manner that replicates the research process, e.g., by using an inductive teaching approach such as inquiry-based or problem-based learning. The potential for inductive methods to achieve the benefits frequently claimed for bringing research into the classroom (e.g., the ability of faculty to share their research experiences in ways that enhance their own and their students' enthusiasm, the development of students' research skills, and the motivation and training of students to pursue research) seems clear. However, the effectiveness of inductive methods at achieving those outcomes in practice, and whether a faculty's research experience truly provides a depth of experience that can enhance their ability to implement these methods, remains to be demonstrated. In addition, there are challenges in persuading faculty to adopt inductive teaching methods and equipping them to implement the methods successfully, a point we return to in the recommendation section.

III. UNDERGRADUATE RESEARCH

Engaging students in research projects is frequently cited as an effective way to link faculty research and undergraduate teaching, a major goal of this study. Sabatini [35] cites several examples of how undergraduates and high school students can be involved in engineering research, and the NSF Research Experience for Undergraduates (REU) program [36] promotes and supports research involvement. While this activity clearly has the potential to benefit students (proposition 1), determining whether undergraduate research strengthens the research-teaching nexus in practice (proposition 2) requires an analysis of how much undergraduate research programs have benefited students and what percentage of students have reaped those benefits. It is also worthwhile to examine how programs should be structured to maximize any benefits and extend them to a broad spectrum of the student body.

Pascarella and Terenzini [37], drawing on an extensive literature base, note several positive outcomes for students who participate in undergraduate research programs, including greater retention in the curriculum and greater likelihood of enrolling in graduate school. On the other hand, Seymour et al. [38] question much of the literature in this field, arguing that most studies of undergraduate research did not include proper control groups, used biased samples, inferred causation from correlation or failed to provide sufficient details of their evaluation methods. The sections that follow contribute to the scholarly analysis of this question by providing an overview of the relevant research, keeping Seymour's cautions in mind, and organizing the major findings in terms of the types of student benefits reported.

A. Retention of Students in Academic Programs

Astin [22] looked at data from over 24,000 students on over 300 college campuses and found that undergraduate student research involvement correlated positively with the students' attainment of the bachelor's degree, commitment to the goal of making a theoretical contribution to science,

and self-reported growth in preparation for graduate or professional school. He also found positive correlations between research involvement and a broad range of self-reported growth measures and satisfaction with many aspects of the educational experience. Results similar to Astin's are reported by Heath [39], who used Astin's stepwise multiple regression approach to analyze data on over 26,000 students. Nadga et al. [40] examined the effect of participating in the University of Michigan's Undergraduate Research Opportunity Program (UROP) in a study that included over 1,200 students in matched control groups. Students who participated in the UROP program had higher retention rates than those in the control groups, even when the contributions of prior grades, standardized test scores, and ethnicity were factored out; however these findings were only statistically significant for African-American students (10.1 percent vs. 18.3 percent, *p*_0.03). The average attrition rate for Caucasian students in the UROP program was about half of that for the matched control group (3.2 percent vs. 6.1 percent), although the difference was not statistically significant, and Hispanic students in the UROP and control populations had almost identical attrition rates (11.6 percent vs. 11.3 percent).

The critical elements of UROP are worth mentioning in view of the program's success. Those elements were early student recruitment, peer advising, formation of peer research interest groups, active recruitment of faculty, mutual selection of students and faculty advisors, opportunities for research presentations, and student choice of the academic credits assigned to the research course and the type of assessment to be used. Nagda et al. [40] observed that the study provided little basis for determining which components of UROP were especially effective in promoting student retention, but they speculate that regular faculty contact and peer mentoring were significant factors. In separate studies, Lopatto [41] and Alexander et al. [42] reached similar conclusions about the importance of faculty establishing a good mentoring relationship with their advisees.

Lopatto also speculated that the relative ease of doing so at smaller institutions explains why programs lacking the impressive research facilities of larger schools still produce higher proportions of students who go on to graduate study. The identification of good mentoring relationships as a key component of the programs raises an interesting research question as to whether many of the student benefits of mentored research stem primarily from close student faculty interactions that might be achievable in other ways that might be less resource-intensive.

B. Pursuit of Graduate Study

Several articles suggest that involving students in undergraduate research promotes their subsequent pursuit of advanced study. Even if this outcome were confirmed, it would not guarantee that the research involvement led to the acquisition of greater knowledge or skills, but most faculty members would consider it a positive effect and so we will summarize the relevant evidence.

Heath [39] found a significant positive correlation between undergraduate research involvement and pursuit of graduate study for both Caucasian and African-American students, with the effect being stronger for the African-Americans. Fitzsimmons et al. [43] similarly found that participation in the NSF-sponsored REU Program had a positive effect on students' plans for graduate study. Of almost 2,000 students surveyed, 75 percent anticipated pursuing a graduate degree before participating in the program and 92 percent reported their intention of doing so after participating. Also, 80 percent of the students reported that participating in the program increased their interest in science and engineering. Kremer and Bringle [44], using nonrandomized but comparable control groups, found that participation in a summer research experience positively influenced students' likelihood both to work in their major field of study and to attend graduate programs that were more highly ranked with respect to research productivity.

However, not all studies show the same impact of research involvement on the decision to pursue graduate study. Lopatto [45] surveyed over 1,000 student participants in research programs at 41 institutions. More than 83 percent of the respondents reported that the experience did not affect their prior decisions about pursuing graduate study; only 3.5 percent of the respondents reported that the experience changed their mind positively about attending graduate school; and 4.5 percent had planned to attend but decided not to do so as a result of their research experience. The strongest support for the hypothesis that research involvement positively influences the choice to go to graduate school comes from programs designed for African-American students.

Seymour et al. [38] note that such programs often differ from other research programs in that they tend to engage students early in their academic careers, perhaps as early as high school, and generally extend over two summers of research experience. In a continuation of the previously cited studies by Nagda et al. [40], Hathaway et al. [46] carried out a controlled study comparing students who participated in research with non-participants. Both the research and non-research groups were randomly drawn from a population of students who applied to participate in the research program, so selfselection bias was not an issue. There were no statistically significant differences in subsequent graduate school attendance between Caucasian or Asian-American participants and non-participants; however, roughly 80 percent of African-American participants attended graduate school while only 57 percent of the non-participants did so, a statistically significant difference (p _ 0.01). Less rigorous studies reported by Foerstch et al. [47] and Alexander et al. [42] led to similar conclusions: research program participants stated that their involvement made them aware of research as a viable option, gave them the confidence to pursue graduate school, and led them to pursue graduate school in numbers significantly higher than the national average.

C. Cognitive Learning Gains

While many authors claim or imply that participating in research promotes significant knowledge gains and other cognitive benefits, empirical evidence for such claims is thin and sometimes contradictory. Fitzsimmons et al. [43] report, for example, that faculty advisors of REU projects claimed that the experiences helped their advisees acquire substantive knowledge of the field but the advisees themselves did not fully agree.

We found only two studies that provide support for claims that research promotes cognitive gains. Rauckhorst [48] studied the impact of a summer research experience on students' intellectual development, using the Baxter Magolda epistemological reflection model [49] as the basis of his assessments, and found that the student researchers were more likely to make the transition to independent knowing than were students in a control group. Ishiyama [50] examined the impact of research participation on the performance of political science students taking the Major Field Aptitude Test. He found that students who presented collaborative conference papers performed better on this test than students who did not, even adjusting for "raw ability" as measured by their incoming ACT scores. Such studies suggest that involving students in research may result in learning gains or other forms of cognitive development, but more extensive studies are needed to draw firm conclusions.

D. Acquisition of Research Knowledge and Skills

Several studies examine how well involving undergraduate students in research promotes the acquisition of research-related skills. Kremmer and Bringle [44] note that students who engaged in an intensive ten-week summer research experience reported greater increases in research skills than did students in a control group. Kardash [51], Seymour et al. [38], Lopatto [45], Kardash [51], and Zydney et al. [52] present similar self-reported gains in research skills resulting from research experiences. Ryder, Leach, and Driver [53] report that research experiences enhanced students' understanding of the nature and development of scientific knowledge, while Seymour et al. [38] report student claims that research helped them "think like a scientist," and Lopatto [45] reports

students' self-assessed gains in understanding the research process as a result of their own research experiences. While these claimed benefits of research involvement are plausible, they are all based on self-reports rather than direct assessment of gains in research skills. A study that involves such an assessment would be a worthwhile contribution to the literature.

E. Affective Outcomes

One of the strongest and most consistent findings regarding student involvement in undergraduate research is that students (and faculty) overwhelmingly find it to be a positive experience. Bauer and Bennett [54] surveyed 986 alumni (59 percent of whom had majored in engineering or the sciences) and found that students who participated in undergraduate research reported greater overall satisfaction with their undergraduate experience and more positive perceptions about whether their education enhanced their "ability to develop intellectual curiosity, acquire information independently, understand scientific findings, analyze literature critically, speak effectively, act as a leader, and possess clear career goals." The statistical analysis that led to this conclusion took into account the students' entering grade-point averages. Seymour et al. [38] interviewed 76 students who participated in summer research programs and found that 91 percent of their statements about their research experience related to gains, lending "substantial support to the proposition that undergraduate research is an educational and personal-growth experience with many transferable benefits." Similar results are reported by Rauckhorst [48] and Lopatto [45].

F. Limitations of Undergraduate Research

While students clearly benefit from being involved in research, the benefits generally reach only a limited subset of the student population, with the participants being mainly top students. Of the 91 research institutions surveyed by Katkin [55], only seven reported having a research requirement for all graduates, 16 percent involved 75 percent or more of the students in research, and 48 percent involved fewer than 25 percent of them. Research is a resource-intensive activity, requiring laboratory space, specialized equipment, and considerable faculty time. Undergraduate research may thus consume valuable resources to benefit a relatively small number of students-resources that might instead be directed to instructional activities that could benefit most students. It would be worthwhile to study the costs and benefits, both educational and with respect to enhanced research productivity, of involving undergraduate students in ongoing research programs. Most universities do not have the resources to provide research opportunities to all undergraduate students, and some question the wisdom of trying to do so [55]. The major limitations are resources and the rising expectations for faculty research productivity. This latter restriction is increasingly addressed by relying on doctoral students and research staff to provide undergraduate research supervision and mentoring. A discussion of the different challenges in stimulating and sustaining increased undergraduate research at both public and private institutions is provided by Merkel [56].

In summary, the answer to the question "Has undergraduate research been shown to strengthen the research-teaching nexus in the sense that it produces better learning?" is a qualified yes. Involvement in research has been shown to correlate positively with student retention, with the greatest observed effects being seen for African-American students, and most participants in undergraduate research programs report that their experiences were both instructive and enjoyable. Research participants also report gains in research related skills, although direct measures of these gains is currently lacking, and there is very little evidence that undergraduate research has much of an effect on students' content knowledge. Research involvement may also have a positive effect on students' plans to pursue graduate study. Finally, undergraduate research at most universities is limited primarily to relatively strong students who constitute a small percentage of the student population, so that the impact of whatever benefits may exist is similarly limited….'

3.2. Institutional Strategies to link teaching and research

Alan Jenkins and Mick Healey

Please note that the text below is an abstract. The full publication can be downloaded from the Budapest Seminar website: http://budapest2012.bolognaexperts.net

'…. 6. In conclusion: back to the future

> "Research activity can and does serve as an important mode of teaching and a valuable means of learning … student involvement in research is an efficacious way to educate throughout the education system the great mass of students
> as well as the elite performers
> for the inquiring society into which we are rapidly moving" (Clark 1997
> p.242)

The above analysis has emphasised:

a) the national contexts where governments are in effect often working to break or ignore the importance of linking teaching and research

b) the view that student understanding of the complexity of knowledge is what distinguishes higher education

c) that the research evidence is not the 'bleak picture' that some governments have presented and does not justify creating 'teaching-only' universities

d) the reality that the 'traditional' model of the teacher and researcher surrounded by a small group of students is clearly impossible in the context of today's higher education. What is both possible and essential is to 'reengineer or 'reinvent' higher education to ensure that all students in all higher education institutions learn in a research environment

e) the perspective that in valuing 'linking teaching and research' institutions need to intervene purposely to maximise the potentially positive relationships and minimise any negative consequences

In particular, we have sought to show the wide range of interventions that have been made by institutions internationally. We have still much to learn, but we also have much to build on. In our view the way forward is, in part, to 'go back' to the view and the academic values of 'teaching and research' and 'student and academic' as being linked in a common enterprise, as we saw in section 1 enshrined in the (UK) Robbins Report in 1963. Recently these values have been developed and reinvented through concepts of 'co-learning' and 'communities of inquiry.' (Brew, 2003; Healey, 2005a; Le Heron *et al*., 2006; Robertson and Bond, 2005)

Angela Brew's (2005) challenge to us in bringing teaching and research together is: 'how can we create inclusive scholarly communities of learning where the academic venture is viewed as a partnership between individuals who bring different skills, levels of expertise and interests to it?' She also asks whether institutions, in seeking to bring teaching and research together, bring students into research, but keep them at arm's length, or are they invited and supported to come into our communities of researchers? A further challenge is whether we work in partnership with students inquiring into the best ways to learn together (Brew, 2005).

At national levels there are reasons to be optimistic about the policy climate in which institutions will be operating. Particularly significant are the thinking and policies recently developed by the influential (US) National Science Foundation. It recently revised all its grants and policies based on the perspective that:

- "Research and education are not – and never have been – mutually exclusive realms" (from GPRA Strategic Plan FY106; Core Strategies; cited in Rameley 2004)

- "Effective integration of research and education at all levels infuses learning with the excitement of discovery. Joining together research and education also ensures that the findings and methods of research are quickly and effectively communicated in a broader context and to a larger audience." (GPRA Strategic Plan FY01-06; cited in Rameley, 2004)

With these perspectives and values in 2003 the National Science Foundation has radically redesigned its programmes and grants to ensure that the 'methods of research are quickly and effectively communicated in a broader context and to a larger audience' (NSF, 2003). This has led to a signifi cant strengthening of a whole range of policies and funding streams to bring teaching and research together (Kaufman and Stock, 2004).

In the UK, the response to the Government's proposals to create 'teaching-only universities' and fears as to the impact of the RAE on teaching-research relations led to the Government establishing the Research Forum to examine teaching research links in the context of growing research selectivity.

The Research Forum Report (June 2004)
www.dfes.gov.uk/hegateway/hereform/heresearchforum/index.cfm

The report concluded that:

* *"research and teaching are essential and intertwined characteristics of a university which can be advanced from two perspectives:*
- *that of the students acquiring a 'higher education', and*
- *that of the work of academic staff employed in higher education …."*

* *"International experience suggests that there are various ways in which from vicarious exposure to the current research of their teachers through to the immediate impact of being researchers (broadly defined) in their own right …"*

* *"… It is becoming clearer that those students who are not learning in an HE environment that is informed by research, and in which it is not possible to access research-related resources, are at a disadvantage compared to those who are …"*

The group then proposed a special fund for those outside the research élite to support student learning in a research environment.

The Funding Decision from DfES (December 2004)
www.hefce.ac.uk/news/hefce/2004/grantletter/letter.asp

"The Higher Education Research Forum was set up a year ago under the chairmanship of Sir Graeme Davies, to look into how we could more closely link teaching and research. One of its main proposals was that less research-intensive institutions should be supported in developing a research-informed teaching environment. We support the principle of this proposal and have therefore included in the attached teaching grant figures sums of £2.5/7.5/15 million over the next three financial years for this purpose. We anticipate that HEFCE will allocate these funds according to a formula in inverse proportion to current levels of research funding, and expect the Council to manage this funding in a way which minimises the burden on individual institutions."

Clearly these funds are limited, though they will be welcome to many institutions. What is more significant is the shift in Government thinking and the recognition that for universities to support honours-level dissertations their students need to learn in a 'research-informed environment'. It remains to be seen whether other countries, such as New Zealand and Australia, which are embarking on their versions of the RAE, will also recognise the need to retain and enhance research-informed teaching environments.

However, important as these national issues are, that is not where we should end and hopefully you 'begin' or 'carry on'. The danger of ending with a discussion of national policies is that this might suggest that without effective national policie there is little that institutions (and departments) can do. We hope that his booklet shows that much has already been achieved by institutions worldwide, often in unsupportive national environments; and that it will help you to reflect on what you already have in place in your institution and five you ideas and strategies with which to go forward….'

3.3. From Problem-based Learning to Undergraduate Research: the experience of Maastricht University in the Netherlands

Ellen Bastiaens and Jan Nijhuis

Please note that the text below is an abstract. The full article can be downloaded from the Budapest Seminar website: http://budapest2012.bolognaexperts.net

In the current knowledge economy, information quickly becomes obsolete as new knowledge becomes available based on technological developments. Therefore it is important to educate young people to look at existing knowledge critically and then to teach them how to generate new knowledge. Due to limited resources, packed curricula, and limited involvement of researchers in bachelor's degree programs, this is easier said than done.

The Boyer Commission (1998) called for more attention to the integration of education and research. In the Netherlands the need for more research embedded in academic bachelor and master's programs has also been recognized (Commission Veerman 2010). This can produce a more challenging learning environment for ambitious and motivated students and can help university staff identify potentially talented young researchers. One of the educational formats with a clear research component is problembased learning (PBL) (Spronken-Smith et al. 2008; Levy 2011). PBL has been the core of education at Maastricht University (UM) since it was founded in 1976, and in fact UM is the first university in the Netherlands that applies this effective and successful system in all its programs.

Problem-based learning has several specific characteristics. First, it is student centered, which means that students are personally responsible for their academic education. Second, students work in small tutorial groups, conduct discussions, exchange knowledge, and formulate their own learning goals as a group. This motivates them to do research themselves. Third, tutors guide the group process, ask critical, substantive questions, share their knowledge, and support students when needed. In this way, students get the maximum benefit of tutors' expertise. Fourth, students' learning is supported by learning and resource centers that offer an extensive selection of study materials tailored to the subject matter currently being examined by students. Although PBL has a clear research component, its transformation into undergraduate research (UGR) requires some adjustments, several aspects of which we discuss in this article.

The Road to Undergraduate Research

As we've noted, problem-based learning is at the core of the educational format of Maastricht University. This approach was introduced because of the need for a new kind of graduate, one able to work across disciplines, work in teams, exercise self-discipline, and undertake lifelong learning. In the PBL system, students work in small groups (10 to 13 students) on actual or simulated problems under the supervision of a staff member. The problems involve short descriptions or compilation of phenomena and events that have relevance to the real world. In Box 1 an example of a problem is given. These problems, however, are not presented by a client (there's no real ownership of the problem) nor is there an actual presentation of the solutions/suggestions to the client.

The problem has to be analyzed, explained, and/or solved by the tutorial group in terms of underlying principles, mechanisms, and processes (Moust, Bouhuijs and Schmidt 1989; Van Berkel et al. 2010).

The problems are processed during two sessions. In the first session, prior knowledge is activated by brainstorming about possible problem statements. As a conclusion, the learning goals are formulated. After this session, students study literature on their own with the aim of meeting the learning goals. Ideally, no specific chapters of reading are assigned, and students are required to find literature by themselves. In the second session, students report on their responses to the learning problems and check that the learning goals have been met. If necessary, new learning goals are formulated.

…

By using PBL, students develop research skills in formulating research questions, selecting relevant sources, analyzing literature, comparing different sources of information, and applying literature to situations. Furthermore, they develop social skills and a positive attitude to lifelong learning. In addition to the discussion of problems, there is room to discuss papers, presentations, or case analyses. Although PBL may look like a standardized procedure, there is a broad range of designs for its implementation. However, the starting point of the learning process is always the introduction of a problem to the students.

To further encourage talented and motivated students to critically evaluate existing knowledge and create new knowledge, the government established the Sirius program, which offers many extra activities for such students.

Spronken-Smith (2008) has classified PBL as a subset of inquiry-based learning, and states that the focus on research could be even stronger if more attention were paid to both the knowledge gap in a discipline, rather than what students don't know, and the production of new knowledge, rather than the transfer of existing knowledge to students. For example, using problems of existing companies can improve the social relevance of research, as well as train students to develop research skills, apply new knowledge, and present their findings to a different kind of

audience. As a consequence, most projects in the Sirius program will be custom-made for the students and require another educational format. Several hurdles must be overcome, however. First, because the PBL system requires the students to work in teams with the same learning speed and similar learning paths, it is difficult to have a custom-made learning path for the more talented student. Another hurdle is the Dutch culture of egalitarianism, in which it is difficult to create something special for people who are already talented.

Based on a request for grant proposals by the Sirius program, a group of enthusiastic educators and researchers at Maastricht University wrote a proposal seeking a grant to extend the current PBL system to undergraduate research. Two main differences in the research orientation are the amount of time actually spent on just one research question and the fact that the undergraduate research students are working on authentic problems, presented by actual clients or as a part of a large research project at the university.

The framework developed by Willison and O'Regan (2007), which described research skills, was one of the leading elements in the successful proposal for a grant to establish the Maastricht Research Based Learning program. The program has three key elements. First, in small groups supervised by renowned researchers, students work on fundamental or applied research over a longer period of time, five months instead of eight weeks. The students learn to think independently and to cooperate with researchers. A small scale is essential, because only then can subtle learning and interaction with university researchers (in a traditional master-apprentice relationship) take shape. With this approach, the development of more critical and analytical thinking and scholarly work is actively encouraged. Second, it is preferable that this work take place in a setting in which students learn together with students and staff from other disciplines. Third, socially relevant partners or businesses also contribute research questions.

Implementation

This research-based learning program is coordinated by a steering board (with a project manager directly under the supervision of the vice chancellor of the university) and board members from the different faculties, who coordinate the actual implementation of the research projects at the faculties. The steering board is responsible for monitoring the quality of the research projects, communication about the program, the financial compensation for faculty members tutoring the students in their research project, and the development of tools for evaluation. To monitor the quality of the research projects—the academic level of the tasks conducted by students and the skills learned—a set of 10 criteria have been developed. The research projects conducted by the students last for at least three months in the final year of their bachelor's degree program, mostly combined with their bachelor's thesis. Students obtain 17 or 18 European Credits (ECTS), for their research project, roughly the equivalent of credit for three regular courses. Thus the undergraduate research is part of the curriculum, rather than being extracurricular or summer research, as is often the case in the United States.

Students meeting certain academic and progress standards can submit a research proposal or letter of interest. Based on these, students are invited for a short interview with a faculty member and then accepted or rejected. Exceptions are made for students who don't meet the criteria for the program, based on an assessment from a student's tutor. Our experience has been that motivation is far more important for a successful completion of the research project than grades.

All faculties at MU have produced detailed project proposals that have been accepted and implemented for this research based program. Courses on research and the availability of space for innovation in the educational program differ by faculty, so the formats of undergraduate research also differ. Although the formats differ, they have two aspects in common—students write a research paper and the research done by students helps to develop new knowledge or ideas. In their research paper, students have to write a section on the theoretical background,

describe the research method, analyze the results and discuss the findings. (A series of these research papers will be published quarterly.)

…

Experiences with Research-Based Learning

Most participants in the new program are in their third year in the bachelor's program. On average 200 students (8 percent of the approximately 2,500 third-year students) participate in different research projects each academic year. In the last two years, more than 400 students (of an annual enrollment of around 9,000 bachelor's degree students) entered the research-based learning program. Based on the regular course evaluations and some additional information from meetings with students and tutors, participants' first impressions of the program are very positive.

…

Faculty members are positive about the program. It offers them the experience of working intensively with highly motivated students for an extended period of time, which enables them to spot the potential of students to further their academic careers, for instance, as student assistants or in research master's or doctoral research programs. Another positive point mentioned by faculty members is that the program can inspire students to pursue a research career, even students who were initially skeptical about doing research. One of the staff members stated:

"The positive aspects for me were working with students on very interesting subjects, providing new and unexpected insights."

The academic quality of the students is reflected in several ways, including the increase in numbers of students participating in academic meetings (e.g., conferences and seminars) and even publishing in peer-reviewed scientific journals within their disciplines. To stimulate this even more, scholarships are granted for attending conferences or writing an article for a peer-reviewed journal. At least twice each year Maastricht University publishes a selection of the best of the student research papers written in that academic year. Maastricht University students also are well represented at the annual Student Research Conference in the Netherlands, organized by the Association of Universities in the Netherlands.

Another way in which the academic development of students is becoming increasingly visible is that many participating students who had never before considered them are now considering academic careers. Thus the research-based learning program is helping students explore their scientific ambitions and see themselves as part of the academic research enterprise.

Roadmap for the Future

Research-based learning has been carried out for two years and has been implemented in all faculties and in different academic programs. Staff and students are aware of this new learning environment, and student numbers are growing. The first evaluations show that the program has been successfully implemented and appreciated by both staff and students. However, there is room for improvement.

To maintain the program, it should be much more imbedded in the student curriculum, thereby making compensation for the staff more explicit and delineating more clearly what responsibilities the central university management has for the program and what responsibilities the faculties have.

Adjusting the model to accommodate a wider range of students also would require several adjustments. At the moment, the projects are custom-made and are supervised by highly qualified faculty members who are motivated by the high quality of the students and by the special learning environment for these students. A wider range of students would require either more parallel projects in a curriculum that makes this difficult or students will have to work in groups on projects, whereby the average intellectual contribution of the student will decrease. This can frustrate the excellent students and also the staff members who prefer to work with excellent students.

Given the intensity of the research projects envisioned in the program, it is not suitable for all students. However, all students at Maastricht University come in contact with research within their disciplines, for example in the form of conducting small-scale research as part of groups of students (either duplicating existing research or conducting new research) or by discussing research articles in tutored groups. Two faculties have now revised their curricula, embedding more research elements in them, beginning in the first year. A third faculty now has introduced a research-based curriculum for all students, with the undergraduate research project available for the top 20 percent of the students in their third year.

Another improvement needed is the involvement of relevant social partners and businesses in the research projects. In some faculties this already has been implemented, but other faculties are still searching for appropriate partners. A third area for improvement is creating a community of learning around undergraduate research—creating a more structured environment for it. Therefore plans are under way for meetings in an informal setting between students and academic staff members, thus stimulating interfaculty cooperation and allowing the easier exchange of research knowledge and experiences.

CHAPTER 4: CONTRIBUTIONS FROM THE SEMINAR SPEAKERS

4.1. Keynote Speeches

Research Based Education: Outcomes of a shared approach in Scotland

Andrea Nolan, Senior Vice-Principal and Deputy Vice-Chancellor, University of Glasgow

The Scottish Higher Education sector has considered the topic of enhancing graduate attributes through research-teaching linkages as part of the Scottish Enhancement Themes. The Enhancement Themes aim to enhance the student learning experience in Scottish higher education by identifying specific areas (Themes) for development. The Themes encourage academic and support staff and students to share current good practice and collectively generate ideas and models for innovation in learning and teaching. They are a key element of the Quality framework in Scotland (www.qaa.ac.uk/scotland/qualityframework).

The sector work confirmed the premise that the research – teaching linkage is central to teaching and learning in higher education. There was wide ranging good practice and evidence of research-teaching linkages throughout all levels of the Scottish undergraduate curriculum alongside an increasing focus at on explicit statements of graduate attributes. Challenges for the sector were identified including: ensuring structured approaches to developing research-teaching linkages, both horizontally and vertically across the curriculum; ensuring students are aware of the purpose of linking research and teaching and progressing student engagement with research processes as well as research based content; increasing need for reward and recognition structures that value research-teaching linkages as providing a process-based environment of learning, rather than just privileging research productivity. It was also widely acknowledged that that research teaching linkages enhance the development of core employability attributes. Follow on work in institutions to articulate graduate attributes more explicitly has been completed and the sector is now considering approaches to the development of the curriculum that will support delivery of graduates fit for successful careers internationally.

European Institute of Technology

Endika Bengoetxea, Senior Education Officer**,** EIT

Europe's need for highly skilled and entrepreneurial graduates, in particular Masters and PhDs, will continue to grow in the years ahead. Europe not only needs employees but also future employers and entrepreneurs. The EIT"s educational mission is to deliver a unique brand of excellent and relevant education responsive to both business and societal demands, focused on innovation, entrepreneurship and creativity through its Knowledge and Innovation Communities (KICs).

KICs are introducing innovative approaches to graduate education by developing new European masters, doctoral and post-doctoral curricula, integrating scientific progression with entrepreneurial and creativity skills with a focus on the thematic areas of the KIC: Climate change, Sustainable Energy and Future Information and Communication Society. Business partners are actively engaged in curriculum design, teaching activities, as well as joint supervision of Master

and PhD projects. Geographical and cross-organisational mobility are built-in elements in the programmes, as well as active engagement in entrepreneurial activities at the different co-location centres of the KICs. Active and student-centered learning methods and new delivery mechanisms are promoted. The key EIT educational activity is to work with the KICs to ensure the implementation of a set of pre-defined quality criteria and EIT overarching learning outcomes for these programmes. Notably, one of its main achievements has been the setting up of an EIT label for master and doctoral degrees focusing on these aspects.

The objective of the presentation is to describe the EIT's higher education agenda and its links with the areas of entrepreneurship innovation, including the latest developments regarding entrepreneurship education within KICs as well as the main challenges for the near future. Notably, the presentation will focus on describing the main aspects of EIT labelled degrees as well as its main quality criteria and learning outcomes that characterise EIT labelled degree programmes.

4.2 Training Groups

A Workable Strategy: How to Develop a Horizon for Research Based Education in my University

Mick Healey, Emeritus Professor University of Gloucestershire

We need to encourage universities and colleges to explore new models of curriculum. … There are several models that we might explore. They should all: … Incorporate research-based study for undergraduates. Paul Ramsden (2008)

Postgraduate study is too late to start; research attributes need to be integrated fully into undergraduate courses. Ian Diamond (2010)

Universities need to move towards creating inclusive scholarly knowledge-building communities. … The notion of inclusive scholarly knowledge-building communities invites us to consider new ideas about who the scholars are in universities and how they might work in partnership. Angela Brew (2007, 4)

My interest in developing research based education originated through explorations over the last decade into ways to enhance the linkage between teaching and discipline-based research. The conclusion to arise from that work is that one of the most effective ways to do this is to engage our students in research and inquiry; in other words, to see them as producers not just consumers of knowledge. The session will explore the variety of ways in which undergraduate research and inquiry based learning are undertaken and the strategies institutions can put in place to foster this approach. The argument will be illustrated using numerous mini-case studies from different disciplines and departments in Europe, North America and Australasia. By the end of the workshop you should have identified and prioritised a range of strategies for embedding undergraduate research and inquiry across different institutions in your country.

What are the different ingredients for Research Based Education and how are they implemented?

Ellen Bastiaens, Programme manager MaRBLe and PREMIUM, Maastricht University

Research Based Learning at Maastricht University: an in depth analysis of this educational model

One of the educational formats with a clear research component is problem-based learning (PBL). PBL has been the core of education at Maastricht University (UM) since it was founded in 1976, and in fact UM is the first university in the Netherlands that applies this effective and successful system in all its programs. By actively addressing a number of issues in meetings with tutorial groups, students better grasp the theory and learn to apply their insights to various questions. The achievements of our graduates demonstrate that Problem-Based Learning is effective. Students from Maastricht University are assertive, independent and expert professionals, skillful in analyzing complex issues, collecting and structuring information, working in international teams, conducting and leading discussions, and creating and presenting ideas. To ensure success in the future, Maastricht University continues to develop her educational model. In 2009 Maastricht University started to implement research in a large part of her curricula as an excellence program for talented and motivated third year bachelor students. The presentation describes the quest of the university and the faculties to achieve a good embedding of the research based learning in her curriculum. It will discuss amongst others the chosen management approach, differences between faculties, and the results and spin off of the program.

Implementing Research Based Education: Challenges and Opportunities – A case study and hands-on exercise

Wolfgang Deicke, Christopher Gess and Julia Rueß, University of Humboldt, Berlin

This workshop will deal with the practical processes of implementing research-based education in the curriculum. Using our own project – the bologna.lab at Humboldt Universität zu Berlin – and experiences as a case study, we seek to identify the key challenges and opportunities advocates of research-based education are likely to face. The case study will be used as a template for participants for a hands-on comparison with their own institutional or national situation.
In the first part of the workshop, we will introduce our project and the practical questions we are facing and the strategies we have adapted in our attempts to promote and implement research-based education at Humboldt University, Berlin. In the second part of the workshop, the participants will get the opportunity to compare and discuss our situation at Humboldt University with their own institution or the wider national context of policy development. The aim here is – by using, adapting and adding to our suggested questions and solutions – to highlight the similarities and differences between different institutional and national contexts and – hopefully – help to put the participants' own projects into a sharper focus.

The discussion will focus – amongst other things – on the following questions:

- How and where are decisions about the adoption and implementation of research-based education made within the institution? Who are the stakeholders?
- What is the institutional discourse around research based education? How can we deal with disciplinary and individual differences in the interpretation of RBE?
- Are there existing examples of RBE in the institution? Can they be used to persuade and promote RBE throughout the university?

- How can we convince teaching staff to adopt RBE strategies? What are the obstacles and possible incentives for them to do so?
- How can we establish and monitor whether RBE is actually working well?

By the end of the workshop participants should have developed a strategy for promoting RBE in their institution, been exposed to different strategies and approaches and know how to further refine their own strategy. Ideally, the discussions should enable all participants to transfer their knowledge to other institutional layers and consider implications for national higher education policy.

CHAPTER 5: BACKGROUND DOCUMENTS

Please note that the following documents can all be found on the Budapest Seminar website: http://budapest2012.bolognaexperts.net

- 'Universities X.0: Integrating new educational and research tools to build networks of ideas, collaborative knowledge-builders, and learning spaces to transform the world into an evolving global campus open to all', François Taddei, Centre for Research and Interdisciplinarity.

- 'Linking Research & Teaching: A selected bibliography' by Mick Healey, University of Gloucestershire (Centre for Active Learning), regular updates are available on the website: www.mickhealey.co.uk/resources

- 'Inductive Teaching & Learning Methods: Definitions, Comparisons and Research Bases', by Michael J Prince and Richard M Felder.

- 'Institutional Strategies to link Teaching & Research' by Alan Jenkins and Mick Healey, The Higher Education Academy (2005).

- 'Linking teaching and research in disciplines and departments' by Alan Jenkins, Mick Healey and Roger Zetter, April 2007.

- 'The potential of research-based learning for the creation of truly inclusive academic communities of practice' by Pete Smith and Chris Rust, May 2011.

- 'Randon Thoughts... The link between Research and Teaching' by Richard M Felder, Spring 2010.

- 'Linking research and teaching in Wales' edited by Simon K Haslett, The Higher Education Academy (2010).

- 'The 'research-teaching nexus' and 'education through research': an exploration of ambivalences' by Maarten Simons and Jan Elen, Catholic University of Leuven, Studies of Higher Education, October 2007.

- 'Does Faculty Research Improve Undergraduate Teaching? An Analysis of Existing and Potential Synergies' by Michael J Prince, Richard M Felder & Rebecca Brent (2007).

- 'Patters in the prevalence of research-related goals in Higher Education Programmes' by An Verburgh, Wendy Schouteden and Jan Elen, Catholic University of Leuven (2012)

- 'Lessons from Problem-based Learning (abstract on: http://ukcatalogue.oup.com/product/9780199583447.do#.UG1Ij_msgXw) by Henk van Berkel, Albert Sherpbier, Harry Hillen and Cees van der Vleuten, August 2010

- 'From Problem-based Learning to Undergraduate Research: The experience of Maastricht University in the Netherlands' Ellen Bastiaens and Jan Nijhuis, Council on Undergraduate Research, Summer 2012

- ‘Developing undergraduate research and inquiry’ York: HE Academy, by M Healey and A Jenkins, 2009

- ‘Undergraduate Research and International Initiatives to Link Teaching and Research’ by M Healey and A Jenkins, Article for Spring 2010 issue of the CUR Quarterly