Advances in Business Education and Training 4

Piet Van den Bossche
Wim H. Gijselaers
Richard G. Milter *Editors*

Learning at the Crossroads of Theory and Practice

Research on Innovative Learning Practices

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Learning at the Crossroads of Theory and Practice

Advances in Business Education and Training

Volume 4

Scope of the series

Advances in Business Education & Training is a Book Series to foster advancement in in the field of Business Education and Training. It serves as an international forum for scholarly and state-of-the-art research and development into all aspects of Business Education and Training. It will not only publish empirical studies but also stimulate theoretical discussions and address practical implications. Also reviews of important developments in the field are encouraged. The editors welcome contributions in which a line of reasoning is illustrated with experiments, design-based studies, best practices, and theory development. In addition, the editors encourage submission of new ideas for business education and training, papers that are not necessarily empirical in nature, but describe interesting new educational tools, approaches or solutions.
The book series will include both edited volumes comprised of peer-reviewed articles as authored books. Each volume is dedicated to a specific theme in business education, and will be complemented with articles that can be a resource to advance business education and training.

Piet Van den Bossche • Wim H. Gijselaers •
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Research on Innovative Learning Practices

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Preface

Business Education is constantly looking for powerful practices to develop the future leaders, and business enterprises want to help graduates to become true experts. The book series *Advances in Business Education and Training* wants to contribute to this search and foster advancement in the field of business education and training. It is an international forum for scholarly and state-of-the-art research and development into all aspects of business education and training. In this way, the book series is one of the platforms of the Edineb-network (www.edineb.org) which brings together professionals in educational institutions and corporate learning centres, who strive for innovation in developing learning environments.

I am proud to present this book *Learning at the Crossroads of Theory and Practice*, the fourth in this series. We want to thank all the contributors for presenting a wide range of interesting ideas. We strongly believe that they offer valuable input to further our capabilities in tackling the challenges ahead. I also want to thank the people who are not so visible, but are indispensable for the success of this series: our reviewers. Below, you can find the names of the people who worked hard to deliver high-quality feedback to our authors. As you all know, this lays the foundation for expert performance. Thank you!

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Chapter 1
Learning at the Crossroads of Theory and Practice: An Overview

Piet Van den Bossche, Wim H. Gijselaers and Richard G. Milter

Traditionally, 'learning' has been always associated with questioning what should be happening within educational institutions. As a consequence, many changes in business education seem to be driven by the idea that it is the business school curriculum that defines what will be learned and that its learning methods contribute to the future career of graduates. The underlying assumption about teaching and learning is that through making changes in course content, improvements can be made in students' learning and the graduates' proficiency in a subject area. However, it is now widely acknowledged that learning is an activity that takes place everywhere. Technological changes—the internet and a wealth of free learning opportunities on the web—provide access to an abundance of information and knowledge. Awareness about the learning potential in any field has become more. Unprecedented change and the speed of knowledge development have challenged both educational institutions and organizations to develop new ways of thinking about how to nurture the expertise that is needed. Continuous learning has become important both for the individual operating in the society and for organizations in international markets (Tynjala 2008).

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At the same time, research on expertise development has indicated that professional expertise is built on different kinds of knowledge: theoretical knowledge, practical knowledge, and self-regulative knowledge (Bereiter 2002; Eraut 2000; van de Wiel et al. 2011). Professional performance—as implied by the level of expertise—is not the single consequence of what has been learned at professional schools, but it is the result of how professional schools connect to professional practice, how schools prepare graduates for continuous learning, and how the workplace endorses continuous development. More importantly, it is the close integration of these three components that is crucial in developing expertise (Tynjala 2008).

This leaves us with big questions. How can we design environments that trigger the integration of these components? How can we design learning environments that, next to theoretical knowledge (our book learning), provide appropriate amounts of practical knowledge and experience? How can we design work environments that provide the trigger to reflect on the experiences and connect with more general, theoretical knowledge? How can we educate learners who are then able to make this connection and regulate their own learning?

As is evidenced in this book, the current views on how learning takes place are at new crossroads. Moreover, learning is happening at these crossroads!

The different parts of this book shed light on different parts of this challenge:

Part 1 of this book examines how business education can design programs in such a way that both theory and practice have a place, and integration is pursued. It looks at the potential of internships and what a good integration of these experiences would imply. Next, different educational formats are presented that enable the link between theory and practice.

Part 2 of the book bypasses the educational institutions and looks at how learning is happening in the world of workplace. This also includes an investigation regarding the conditions in which people are learning. Illustrations are provided to show how work environments can be designed in such a way that learning is fostered.

Part 3 of the book looks at the challenge of enriching our classrooms so that the theoretical knowledge is coupled with rich experience. Different pathways are explored, including the use of games and the full potential of information and communication technology (ICT). Moreover, the learning potential of classroom collaboration is stressed by presenting a methodology to unravel this hidden capital.

Part 4 of the book deals with designing educational environments that tackle the sometimes difficult transition into programs. Questions that are tackled are: How can preparatory programs be designed? How can we guide students in developing self-directed learning skills? How to deal with a lack of prior knowledge in mathematics?

Chapter Overview

Part 1. Integrating Theory and Practice in Business Education

Gerken, Rienties, Giesbers, and Konings examine in their chapter (Chap. 2) the potential benefits and requirements of academic business internships and the implications for supervision. Based on a literature review and a concept mapping exercise,

they identify crucial success factors in the interactions between the three stakeholders: students, companies, and business schools. Rich and Brown (Chap. 3) describe how they tried to integrate theory and practice in a first-year module for undergraduate students by combining traditional formal teaching methods with a range of nonformal methods. Another case is presented by Laughton, reviewing the approach of work-related learning within the 'Venture Matrix'. This chapter (Chap. 4) reflects upon common approaches to work-related learning in business education and the nature of knowledge and skill development in these approaches.

Part 2. Workplace Learning

The chapter of Gijbels, Raemdonck, Vervecken, and Van Herck (Chap. 5) presents a study investigating the influence of job characteristics and the self-directed learning orientation on work-related learning behavior. They conduct this with two interesting samples: students participating in part-time vocational education and employees in an ICT-department. Ketels, Beausaert, and Segers (Chap. 6) explore the potential of Personal Development Plans for stimulating learning and professional development of employees. They focus on the influence of the nature of the perceived purpose on the use and performance. The chapter of Caniels and Kirschner (Chap. 7) takes a broader perspective by studying lifelong learning participation of the working-age population. They studied time spent on informal learning and how this is related to characteristics of participants and what are the perceived outcomes of this engagement in informal learning. In the chapter by Van den Bosch (Chap. 8), learning at the workplace is described at the level of regions. More specifically, it explores the role of regional networks in innovative processes in organizations. In particular, the contribution of higher educational institutions within these networks is scrutinized.

Part 3. Classroom Enrichment

The first chapter in part three by Ebbers, Macha, Schloesser, and Schuhen (Chap. 9) presents a study on the use of games or experiments during the teaching of economics. Effects on different kinds of knowledge are presented. Rienties and Townsend present in their chapter (Chap. 10) a framework that can be used to redesign courses. They claim that in order to provide a rich learning experience, it is important that content, technology, and pedagogy are equally balanced. This framework is used to discuss two examples of redesigned courses in business education. The chapter by Hernandez-Nanclares, Rienties, and Van den Bossche (Chap. 11) identifies a different way to enrich the classroom by focusing on collaboration and knowledge sharing. Social network analysis is presented as a methodology to capture knowledge sharing in the classroom. The authors apply this method and show the potential for future research.

Part 4. Bridging the Gap

The chapter by Sastry and Maclean (Chap. 12) and the chapter by Tempelaar, Rienties, Giesbers, and van der Loeff (Chap. 13) examine the use of remediation programs to ease the transition into programs. Sastry and Maclean focus on the opportunities for Technology Enhanced Remedial Maths. Tempelaar and colleagues evaluate the effect of participation in a remedial online program aimed to improve the success rates in the first year of bachelor studies. The chapter by Pol and Spuls (Chap. 14) tackles the transition from high school to college from a different angle and also examines the self-directed learning skills of first-year studies. In this project, freshmen were coached and encouraged to perform self-reflection.

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Part I
Integrating Theory and Practice in Business Education

Chapter 2
Enhancing the Academic Internship Learning Experience for Business Education—A Critical Review and Future Directions

Maike Gerken, Bart Rienties, Bas Giesbers and Karen D. Könings

Introduction

The transition from life as a student to the world of work is not always easy and can bare a lot of difficulties. Graduates have to adapt to a new working world when they enter the job market, e.g., applying their theoretical knowledge to a work-related context. Often it is assumed that business graduates can directly transfer their knowledge from business education to the workplace and use their acquired skills in their first job (Arts et al. 2006; Mintzberg 2004). However, both research and practice indicates that this is often not the case and that graduates underperform when starting their first job (Arts et al. 2006; Tynjälä 2008). The transition can be eased when graduates know what they are getting into. Tynjälä (2008) indicated that school learning should adopt certain features of work learning in order to integrate theory and practice. Integration can be done through "mediating tools" like academic internships (Tynjälä 2008). Academic internships are defined as an opportunity to integrate work-related experience into graduate education by participating in scheduled and supervised

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work (Gault et al. 2010). These real-world experiences are an integral component of an academic program and provide students with the opportunity to develop not only work skills but also an understanding of the workplace. In the following, the term internship is referring solely to academic internship for undergraduates.

Companies increasingly favor business graduates with work experience (McDonald et al. 2010). Companies expect business graduates to be prepared in terms of practical knowledge, generic and specific skills to start their professional career. However, recent research has highlighted that there is a considerable mismatch between expectations of companies and students (Birch et al. 2010; Gault et al. 2010, 2000; Hurst and Good 2010). For example, students expect to be trained during their internship, whereas companies expect students to be well-prepared before starting the internship so that companies have limited additional costs in training and supervision (Gault et al. 2000; Hurst and Good 2010). Given the mismatch between students' knowledge and skills on the one hand and the demands of companies on the other hand, business schools need to offer internships in order to bring more real-world experience into their curriculum.

The quality of internship learning heavily depends on the quality of feedback and supervision by both the company and the business schools (Narayanan et al. 2010). In order to enhance the learning experience of students while at internships, both companies and business schools have to find a way to effectively support, facilitate, and supervise students while they take and complete their internship. This may be accomplished through Computer-Supported Collaborative Learning (CSCL). Information and communication technology (ICT) tools like web videoconferences or social media now have the power to provide a rich learning experience for students (Giesbers et al. 2009; Rienties et al. 2010) that is also easy to use for teachers and supervisors at the respective company. For example, research in internship supervision at a distance in medical schools has found that internships supported with ICT can be cost and time effective (de Leng et al. 2009). While these recent findings are promising, in business education the majority of internship students follow an internship at a larger geographical distance than medicine students. More importantly, the goals, tasks, and expectations of internships in business education are less clearly specified than in medical education.

Despite the increasing possibilities and affordances of ICT and the increased demand for internships by students and institutes alike, only a few studies exist on internships supervision at a distance through CSCL (Black and Bachman 2007; Carlson et al. 2001; Conroy and Khan 2009; Van Dorp et al. 2008). Clear evidence on the impact of internship supervision in business education through CSCL is still missing. By first reviewing the internship literature and the role of ICT in particular and afterwards conducting a concept-mapping exercise with 22 experts in business and economics education, this chapter aims to answer the following questions: (1) what is the added value of an internship for the three stakeholders according to the literature?, (2) what are the first insights into the implications for interaction between the three stakeholders in internship supervision at a distance?

A Literature Review: The Functions of an Internship for Students, Companies, and Business Schools

Work-based learning in the form of internships is increasingly important for business schools as they increasingly compete for excellent students, and, at the same time, try to establish strong relationships with leading companies. However, there is a lack of empirical research on the effective implementation of internships. Until recently, research on internships in various fields of economics and business has primarily focused on measuring the effectiveness of internships by comparing student perceptions and benefits only at the end of the internship (e.g., Schambach and Kephart 1999). There is a limited understanding of how business schools, students, and companies can effectively interact with each other before, during, and after completion of the internships. The role of an internship may be different for each stakeholder and will shape the way they want to interact with other stakeholders both in form and content. Therefore, a literature review was conducted to identify what each stakeholder is looking for in an internship and (if available) what is the potential role of ICT in the provision of the internship. This affects the information a stakeholder needs to have to make an internship a success and largely determines the form and content of the interaction. For example, a company may not be interested in being informed about all kind of rules and regulations the business school has.

Because of their relevance to the review, we have used the following databases: EBSCO, Web of Science, ScienceDirect, and Emerald Insight. The 19 search terms used in the four databases were: Internships, e-internships, internship satisfaction, student internships, academic internships, internship benefits, business education internship, internship programs, internship graduates, internship undergraduates, ICT internships, distance education internships, community of learners internships, collaborative learning internships, business student internships, work-based learning internship, accounting internship, internship literature review, virtual internships. In order to elaborate the scope of the articles found and to identify relevant articles that were not listed in the selected database, the reference lists of the articles were also taken into account as well as other articles written by the same authors concerning the same topic. The search resulted in 481 articles in total.

Only articles in the field of business and economics education were selected from the list because of their relevance for internships in our context. As a result, 66 articles were selected and reviewed ranging from 1988 to 2010. Afterwards, an in-depth review of these articles was conducted, whereby key terms were selected based upon a two-step approach. First, the important key terms regarding academic internships mentioned in each article were identified, whereby we labeled the key terms to the respective stakeholder(s). This method led to 57 key terms for students, 12 key terms for companies, and 30 key terms for business schools. In a second step, only key terms that were mentioned in five or more articles were defined as relevant for academic internships. This approach ensures that the general findings and trends from the literature are identified. Based on this procedure, 14 key terms were identified as often cited benefits for the three stakeholders. The key terms are

Table 2.1 The functions of an internship for students, company and business schools (ranked on frequency of report in the literature)

Stakeholder	Key terms according to literature (frequency)
Students	Career preparation (14)
	Job satisfaction (11)
	Work-based learning (8)
	Develop communication skills (8)
	Develop job-related skills (8)
	Get sooner job offers (8)
	Develop a stronger resume (7)
	Receive feedback (6)
	Enhance student learning (6)
	Networking (6)
	Real-world experience (6)
Company	Talent screen (10)
Business schools	Reputation enhancement (6)
	Strengthen ties with corporate world (5)

listed in Table 2.1 and are ranked in descending order for each stakeholder starting with the most frequent key term. The table illustrates that most identified research addresses primarily the students' side of internships. This indicates relevance for an integrated approach to facilitate internship supervision at a distance.

Academic Internships Prepare Business Students for the Labor Market

From the total of 14 key terms, 11 relate to students who follow an internship. There is a limited understanding in the literature on the support of internships through CSCL/ICT, as only four articles have specifically mentioned the role of ICT in internship supervision. Therefore only the important functions of internships for students are mentioned here as they can give an indication on the implementation of ICT in internship supervision.

Early studies have shown that accounting internship students improve their academic performance as well as their professional performance compared to students who do not follow an internship—thereby building a strong resume (English and Koeppen 1993; Knechel and Snowball 1987; Knouse et al. 1999; Siegel and Rigsby 1988). Students have the opportunity to acquire valuable experience by integrating the knowledge they gain during their studies in a real-world setting (Beenen and Mrousseau 2010; Hall et al. 1998; Maskooki et al. 1998; Muhamad et al. 2009). Furthermore, studies have shown that internship experience have an effect on career success. For example, the students received higher earnings afterwards in their first job (Callanan and Benzing 2004; Gault et al. 2000; Knemeyer and Murphy 2002). Students also have the possibility to gain appreciation of professional careers and specific skills needed for success in their chosen profession (Beard 2007; Knouse and Fontenot 2008; Maskooki et al. 1998). These experiences provide more realistic job expectations for students (Knouse et al. 1999).

Furthermore, students can develop good working habits and other personal qualities by following an internship. For example, students become more confident in order to contribute towards enhancing the early employment experiences (Birch et al. 2010; Cannon and Arnold 1998; D'abate et al. 2009; Gault et al. 2000; McCollum and Schoening 2004; Sapp and Zhang 2009; Taylor 1988). Students also enhance their interpersonal and communication skills during an internship (Beck and Halim 2008; Brown and Murphy 2005; Sapp and Zhang 2009). As a consequence, students will receive sooner and more high-quality job offers (Gault et al. 2010; Knouse and Fontenot 2008; Knouse et al. 1999; Mello 2006; Rothman and Lampe 2009).

According to the literature, students get the most out of their internship experience when they receive sufficient and relevant feedback from both their academic and company supervisor (Narayanan et al. 2010). Giving feedback of both, the performance and learning opportunities, are key predictors in a study about internship satisfaction (D'abate et al. 2009). In addition, studies reported that feedback is considered as an important element in maintaining the quality of the internship program and supervisors should provide appropriate feedback on the interns' tasks (Brooks et al. 1995; Johari and Bradshaw 2006; Narayanan et al. 2010).

Finally, it is reported that students get the opportunity to network for their first job after graduation, get insights into job-related skills, and as a result experience a higher job satisfaction in their first job (Cook et al. 2004; D'abate et al. 2009; Gault et al. 2000; McCollum and Schoening 2004; Narayanan et al. 2010; Schambach and Dirks 2002). Recent studies have also highlighted the potential advantages for internships. In 2009, the National Association of Colleges and Employers (NACE 2009) in the United States has found that despite the reduction in hiring, students who followed an internship had a distinct advantage to obtain a job above non-internship students. A recent study in the UK has shown similar results (McDonald et al. 2010). However, there are also some drawbacks for students. For example, recent development has shown that students feel exploited by the employers who hire interns without financial compensation. A second drawback is that the learning objectives are not always clear although they play an important role in order to get the most out of the internship experience (Narayanan et al. 2010).

Companies are Looking for Future Employees

The literature identified talent screening as the most cited key term for companies that offer internships. Companies increasingly favor graduates with work experience (Beard 1998) and therefore expect student to be prepared in terms of practical knowledge. Several articles indicated that companies use the internship placement to recruit and select future employees (Beckett 2006; Coco 2000; Divine et al. 2008; Gault et al. 2000; Hurst and Good 2010; Mello 2006; Weible 2010). The costs for hiring are low when graduates can be screened during their internship and it is a suitable method to create a better fit between the intern as a prospective employee and the company (Beard 1998). Internships provide needed part-time help for certain tasks

and employees for special projects that run for a few months (Beard 1998; Divine et al. 2008; Thiel and Hartley 1997). During the internship companies can benefit from the exposure to new ideas coming from the interns and each other's knowledge exchange (Beard 1998; Divine et al. 2008; Tovey 2001; Weible 2010). Employers also indicated that they have a lower turnover rate for employees with internship experience (Beard 2007).

Disadvantages for companies may be that students who are following an internship often do not have any work experience and need guidance in their daily work (Birch et al. 2010). Furthermore, they also may need training and extensive support and feedback before they can become a productive part of the company. This implies that companies have to balance supervisor costs with potential benefits of attracting new employees.

Business Schools Improve Their Curriculum

According to the literature, business schools are looking for reputation enhancement and strengthening ties with the corporate world. Internships offered in the curriculum can lead to a stronger connection between business schools and the business world and can boost the reputation of the educational institution within the local community (Beard 2007; Divine et al. 2007; Gault et al. 2000; Mello 2006; Weible 2010). For example, making contact with the community can increase the corporate support for the institutions in terms of research grants and equipment (Beard 1998; Coco 2000; Thiel and Hartley 1997).

Business schools also have more opportunities for professional consulting and research support, thereby receiving support for their programs and feedback on their curriculum (Beard 1998; Thiel and Hartley 1997; Weible 2010). Building a network via internships makes it easier to bring managers into the courses at business schools (Divine et al. 2008). Internships add to the learning experience of students and increase the attractiveness of the business school to prospective students (Divine et al. 2007; Gault et al. 2000; McDonald et al. 2010). At the same time this can also increase the placement opportunities for graduates.

A Need for Integration of Expectations and Support for Internship Supervision at a Distance

Although the current literature gives a good overview of the functions of internships for each of the three stakeholders, there is still surprisingly little empirical research on the dynamics and interactions between the stakeholders that occur during internships supervision (at a distance). In particular, only a few research articles on internships have provided in-depth understanding on the interactions of the three stakeholders (Birch et al. 2010; Hurst and Good 2010).

Furthermore, in the last years ICT has become a much used tool that provides a rich learning experience for students at a distance. Yet, only a few studies have addressed how ICT can enhance and support the learning experience of students, provide more value for companies, and enhance the relevance for business schools during internships (Black and Bachman 2007; Carlson et al. 2001; Van Dorp 2008). These studies have shown that students, company, and business school are aware of the potential benefits of internship supervision at a distance. However, they do not address the interaction between the three stakeholders using ICT tools. Therefore, in the remainder of this chapter, we will elaborate on a concept-mapping exercise among 22 experts within the field of business and economics education who were discussing key terms of internship provision and support. We, in addition, asked these experts to discuss and reflect upon the potential use of ICT in internship supervision at a distance.

Method

Expert knowledge about attitudes and opinions of internship supervision at a distance was elicited by using a concept-mapping exercise (Giesbers et al. 2007; Hughes and Hay 2001). In this exercise, techniques as brainstorming, concept clustering, and concept sorting were combined to generate in-depth data on viewpoints from experts in the field. According to Cooke (1994), the mentioned techniques are most suitable in knowledge elicitation exercises that involve multiple experts. This method leads to a sumptuous collection of information in a short time and helps to identify the main concepts. The literature review showed that primarily the students' view is addressed and lacks a deeper insight into the view of the company and business school.

Experts in the field of student learning, business and economics education, and E-learning from 15 business schools in six different countries (Austria, Germany, the Netherlands, Spain, UK, United States) were set up during a workshop on internship supervision at the 17th EDiNEB conference.[1] One drawback of a concept-mapping exercise is that experts might be inclined to express their own concerns, agenda, or focus rather than expressing the concerns from a range of stakeholders. However, to encourage experts to explicitly take into consideration the perspective of all the three stakeholders, the 22 experts got a general introduction of the purpose of the study and were randomly divided into three groups. Each group represented one of the three stakeholders in order to get a complete overview and, more importantly, to get a first insight into the interaction between students, company, or business school. For each stakeholder, one of the authors moderated the discussion. The participants discussed the use of ICT in the support of internship supervision at a distance and the expectations therein of students, companies, or business schools.

[1] http://www.edineb.org/. During the international EDiNEB conference in London 2010, leading managers, researchers, and teachers in business and economics discussed innovations, good-practices, and successful integration of innovation in business and economics education.

The three moderators raised the following questions as guidelines for the knowledge elicitation process.

The following questions refer to internship supervision at a distance:

- What information would be important for you before, during, and after your internship?
- What information would be less important?
- What role would you like your student/company supervisor/supervisor from business school to take?
- What actions should come forth of the role of the student/company supervisor/supervisor from business school?
- What communication means (ICT) would you prefer before, during, and after internship supervision at a distance?
- What according to you are the criteria for good (online) interaction between stakeholders?

The discussions lasted around 60 minutes. Each group was asked to write down the discussed topics as statements. Afterwards, a general round-up of all three groups of stakeholders was presented by one representative of the respective stakeholder group, which subsequently was followed by a general discussion that lasted 30 minutes. In this way, the various viewpoints and statements from each of the three 'stakeholders' were addressed, which sparked further discussion. The moderators encouraged all participants to contribute in the discussions. The statements were collected and integrated into a concept map, which was sent after the concept-mapping exercise to all the participating experts.

Results

The results of the concept-mapping exercise led to 70 statements in total that were identified during the discussions as necessary preconditions for successful internship supervision and the respective role of ICT: 31 statements for students, 21 for companies, and 18 for business schools. All experts agreed that effective communication between the three stakeholders is a crucial factor to set up internship supervision at a distance and to facilitate the internship process. Yet, the concept-mapping exercise also revealed substantially differences between the three stakeholders on how to communicate with each other as well as differences on the internship supervision itself, as is illustrated in Fig. 2.1. The results are listed below, separately for each stakeholder.

Students Ask for High-Quality Internships

The seven experts representing the student body divided their 31 statements into four categories: eight statements about clear expectations, eleven statements about the communication, seven statements about the quality of the internship program,

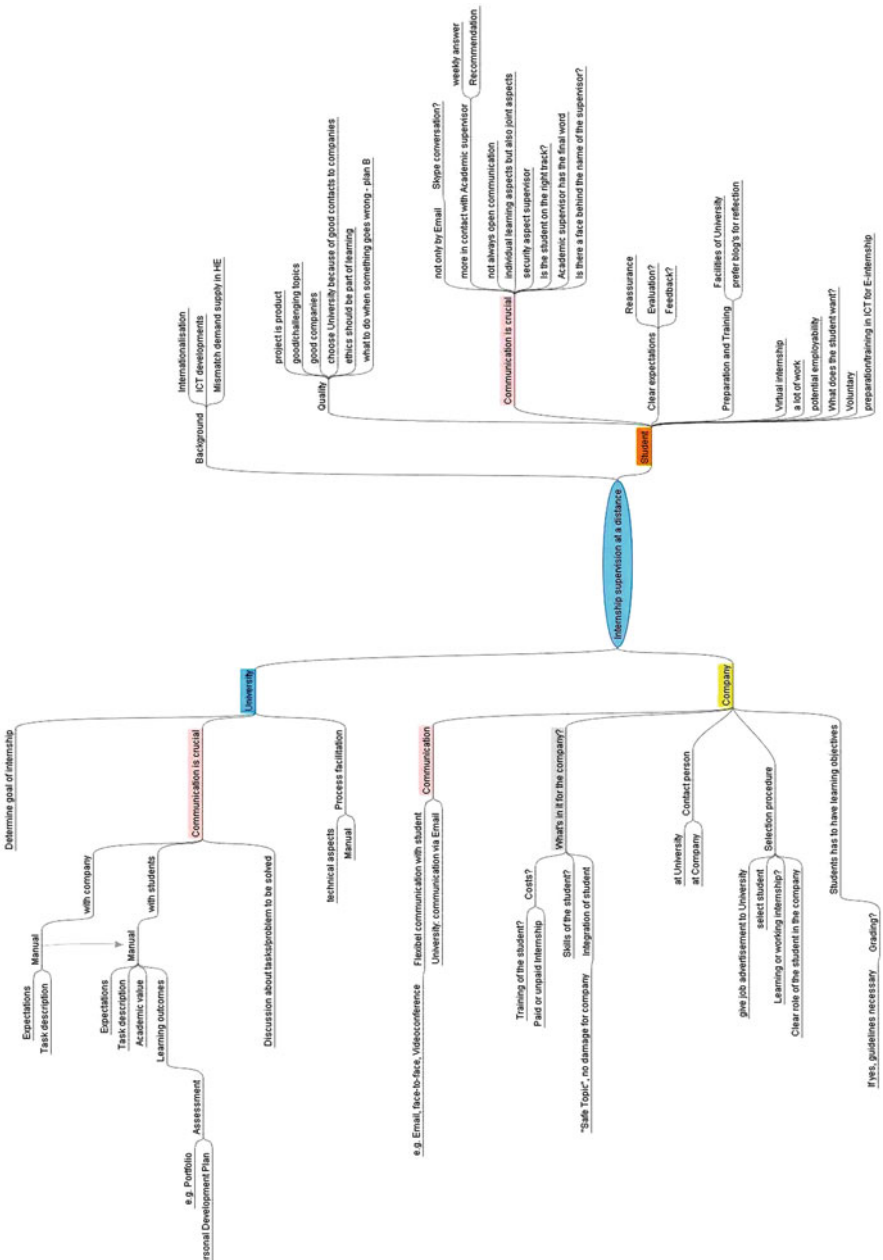

Fig. 2.1 Concept-mapping exercise internship and ICT tools

and the remaining four statements about training and preparation. The experts agreed that students need clear expectations in terms of tasks, workload, payment for the internship, and grading or evaluation. They consider this to be both a reassurance and a motivational stimulus for students to maximize their internships' learning experience. Furthermore the experts suggested that a direct academic supervisor at the business school should be available for questions on a weekly basis via email or telephone. The academic supervisor should monitor the tasks of the student and help out if necessary. A company supervisor should provide daily support to the student at the workplace. At the same time, the experts indicated that the quality of the project or tasks during the internships should be high in terms of challenging topics. Experts also stated that students prefer business schools with a high reputation that have useful business contacts to companies. Finally, the experts agreed that students need to be prepared for the internship by means of a formal training. Students need training for the use of ICT for internship supervision at a distance, e.g., special software.

Companies Receive First Choice of Best Students

In total, 21 statements were issued by the seven experts representing the company. The experts divided them into five categories: seven statements about the benefits for the company, five statements about the selection procedure, three about the contact person at the business school, three about the learning objectives, and three statements about the communication. The experts representing companies indicated that companies need to know the potential costs for hiring an intern. In general the internship should be unpaid and business schools should prepare the student for the internship. The experts stated that companies want to determine the topics and tasks on which the students will work in order to prevent damage to the company. The students should only work on 'safe' topics (i.e., low-risk activities) that have no further consequences when something goes wrong.

Furthermore, companies want to select the students for the internship positions themselves. According to the experts, companies expect to receive a clear guideline from business schools including learning objectives and how to assess the internships, e.g., grading. Finally, companies would like to be flexible in their communication with students, e.g., Email, face-to-face, or videoconferencing. The contact with the Business schools preferably takes place via Email only.

Business Schools Want to Facilitate the Academic Internship Experience

The eight experts representing business schools issued 18 statements, namely: 14 statements about communication, 3 about process facilitation, and 1 about the goal of the internship. According to the experts representing higher education, business

schools should determine the goal of the internship as well as facilitate the whole process. They have to set up a guideline where business schools specify what students should accomplish during their internship. The guideline should also contain information about selection procedure of students for particular internships and define the requirements for academic supervisors. Business schools also determine the learning outcomes together with the company and how to assess these during and after the internship, e.g., grading or giving credits. Finally, in order to enhance the learning experience of internship students, the experts urged business schools to build, maintain, and extend a network of excellent companies that provide excellent learning experiences for students.

Collaboration Between the Three Stakeholders

From a collaborative point of view it can be concluded that the experts representing the three stakeholders have substantially different expectations on how to work together. Experts representing the students want to have regular face-to-face contact with the company supervisor to get most out of the learning experience. The contact with the business school supervisor can primarily be done via Email or videoconference whereby students expect to be trained in the specific technology that will be used. Experts representing the business school stated that it is important for them to set the goals of the internship and assess the student's learning process. Business schools are primarily concerned about the quality of the internship program. Experts representing the company expect that the business school will provide a clear guideline of what the student has to learn. However, companies do not want the business school to interfere in the internship program and the intern's daily work.

Discussion

The goal of this chapter was to examine the potential benefits and requirements of academic business internships and the implications for supervision at a distance by first conducting a literature review and afterwards conducting a concept-mapping with 22 experts from 15 business schools. The literature review revealed that there are several benefits for the three stakeholders—students, company, and business school during internships. According to the literature, the most frequently mentioned benefits are related to students, ranging from career preparation to sooner and better job offers. Companies use the internship primarily for a talent screening in order to hire excellent and talented new personnel. Finally, business schools can improve their reputation and future income streams by offering academic internships in their business curriculum. The literature review also revealed that there is a lack of empirical research on the interaction process that occurs between the three stakeholders before, during, and after the internship. Furthermore, the literature review revealed that at present only a limited number of studies (e.g., Conroy and Khan 2009; Van

Dorp 2008) have addressed the role of ICT in enhancing the learning experience of internships for business students. Given the enormous potential of ICT to provide a supportive community of learning for business schools, companies, and business students, we find this rather surprising.

The concept-mapping exercise aimed to provide a more elaborate understanding of the interactions of the three stakeholders through CSCL and identify how students, companies, and business schools can benefit from internships. Results of the concept-mapping exercise showed that the three actors have different views on the guiding principles of the collaboration. Experts in the company group prefer to stay in close contact with the student as they use the internship for talent screening in order to hire new excellent future employees. From the students' perspective, experts prefer to see the company supervisor face-to-face on a regular basis as well as their business school supervisor. As a result students transfer their knowledge from the business school to the company, but also learn from the company and transfer this knowledge back to the business school. The business school therefore needs to prepare the students for the internship by focusing on learning objectives and outcomes. The knowledge that the interns use during their placement can lead to a stronger learning and a higher satisfaction. While from a business school perspective, experts prefer to be entirely responsible for the preparation of the students, the success of the internship also depends on the company's actions. Business schools and companies would clearly benefit from collaborating together on the internship program by dividing the responsibilities beforehand in order to increase the students' learning outcomes and the quality of the internship experience. For example, companies can help in developing the internship program to provide students with the possibility to learn specific knowledge. This again may increase the possibility of employment with the company as well as the reputation of both the company and the business school and can affect future internship programs.

The concept-mapping exercise suggests that there is a significant difference between the viewpoints of the three stakeholders. In particular, goals and expectations of companies and business schools on internship selection, tasks, and supervision substantially differ, which most likely will lead to a clash of interests when companies and business schools are not explicitly addressing these differences. Also, internship experiences might vary greatly between students as well as their learning outcomes when there is no clear agreement about that between the stakeholders. Therefore, establishing a common understanding between the three stakeholders before starting the internship and a joint guidance of the internship students by both company and business school seems a necessity. ICT technology may provide a means to communicate more intensively together, helping to bridge the differences between the goals and expectations of the company and the university.

The interaction between students, business schools, and companies could be facilitated by creating a social network or community of learners. Therefore, the students, companies, and business schools are required to take a long-term view of internship programs to achieve mutually beneficial outcomes. A social network approach would support this long-term view where the stakeholders can benefit from each other's experience to further improve the internship supervision.

Limitations and Future Research

This research has demonstrated the need for future investigation of the collaboration between the three stakeholders. Some drawbacks need to be addressed by future research. The use of a concept-mapping exercise with experts in the field of student learning is limited to the experts' view. The primary goal was to get an overview of the aspects that they think play a role in the internship supervision at a distance. Given the wide representation of experts from a range of business schools from six countries, a comprehensive body of expertise and experience was present during the concept-mapping exercise, which strengthens the validity and generalization of our findings. Furthermore, by letting experts represent one of three distinctive stakeholders, we explicitly acknowledged that the experts should look beyond their own role in their institute. Given that the results indicate strong differences in the viewpoints among the three stakeholders, there seems to be evidence of experts "crossing their own borders" that have led to a substantial contribution of our understanding of the complex dynamics of academic internship learning experience for business education. Therefore, the results are an excellent stepping stone for further research in the direction of internship supervision at a distance and need empirical support. Based upon the literature review and recommendations of the experts, future research will focus on developing an online community program in the near future in order to further validate the findings and assess whether business students are able to benefit from internship supervision at a distance through CSCL.

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Chapter 3
Combining Formal and Non-formal Learning for Undergraduate Management Students Based in London

Martin Rich and Ann Brown

Purpose and Background

Formal, traditional teaching methods at universities have for centuries been based on lectures and individual learning. These are characterised by heavily structured approaches to teaching and are based on a 'transmissive' model where knowledge is transferred from a lecturer to a student. Non-formal methods, where teaching settings are less structured, and students set out to discover things for themselves, draw on student-based activities and tend to emphasise practical skills learning as well as greater student involvement in work design, peer supported learning and assessment. Concepts such as those proposed by Cross (2007) and Bentley (1998) place schools and universities as facilitators in a complex network, where the most effective learning in practice takes place away from the classroom. In addition, the terms 'semi-formal' learning can be used to refer to teaching methods which contain some structure, but are less centred on knowledge originating with the lecturer than formal approaches.

Eraut (2000) uses the term 'non-formal' learning to refer to a range of different approaches, arguing that 'informal' is an inadequate term to use for anything that is not formal learning. He introduces a typology of non-formal learning as implicit, reactive or deliberative depending on students' use of past and current experiences as well as the behaviour that is expected of them in the future.

First year undergraduate students face an increasingly major transition when they arrive at university. The change from school to university can be profound as students move from the school structured learning environment, managed for them, in which knowledge is acquired in small chunks to fit within weekly horizons, to that of the university, in which they are expected to manage their own learning, to set

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their own goals (to some extent) and in which subjects are taught in term-long modules. Designing and delivering business or management degrees has in recent years been made more complex by employer's demands for graduates who are able to act independently with proficiency at individual business and team working skills. Traditional teaching through lectures remains appropriate for some knowledge-intensive subjects, and when supported by tutorials in the first year can be effective in enabling students to make the first year transition. For subjects like management, this approach is less appropriate. 'A manager is someone who gets things done with the aid of people and other resources' (Stewart 1967) cited in (Boddy 2011). Learning to manage includes both learning the theory and developing the skills needed to successfully apply these ideas in practical situations.

This chapter describes and assesses the experience of developing a module on management based on teaching methods in which the formal lectures are combined with a range of non-formal approaches.

The module, called The Practice of Management, is delivered in the first term of an undergraduate degree programme in management. We, the designers, had a number of aims for the module. It is one of the first modules that the new intake of students encounters and hence it forms an important part of the transition, for most students, from school to university. In this module, students are introduced to the approaches to study required for university degree within a highly structured and supportive environment. Formal aims included in the module specification are such as demonstration of the interdependence of 'hard' and 'soft' tools for management, knowledge of management theory and its practical application, acquisition of individual business and team working skills and the development of self and team reflection. In addition, we also wanted to create a student community as fast as practicable. To do this we set out to create a culture of attendance in which students from a variety of backgrounds learnt to work together and regarded attendance at all classes as an essential part of their studies right from the beginning. With the variety of teaching methods used, we also aimed to offer something for a range of learning strategies favoured by different students.

The analysis given in this chapter takes into account both the experience of and feedback from students during the module itself, and that of students later in their degree programmes, who could judge what parts of this introductory module proved most valuable.

An important part of the context was the programme's location in Central London, and it was clear that the location influenced the student experience in several ways, notably:

- Some students already lived in London before joining the programme and did not want to move
- Conversely, many students came from different parts of the world and were attracted to studying in London because of its reputation as a world city
- These students mostly wanted to be part of a cohort defined by being based in a particular geographical location, so they were inclined to modes of study which placed an emphasis on face-to-face contact

- They were interested in the characteristics of London and its role as a centre for business.

To reflect the diversity of the student cohort, a significant effort was put into ensuring that each team contained students with a variety of backgrounds. The majority of members of each team came from outside the United Kingdom.

Teaching took place in an attractive location within London, in an area where many young people like to live and work. Students had access to a library and related facilities in a specialised business school building opened in 2003. The university had put a considerable effort into providing informal spaces within which management students in particular could work, reflecting the centrality of face-to-face tuition within the degree programme. The university is close to the City of London—the district within London within which the major financial institutions are based. The module took advantage of this factor by including an element of 'psychogeography' in which participants were encouraged to observe and reflect on their surroundings.

Development of this module is an iterative process. It could be viewed as a process of action research where the students' roles are analogous to those of participant observers, and draws on an established tradition of action research in education (Carr and Kemmis 1986). The module design has evolved considerably over the last few years in response to student comments and staff assessments. It is also recognised that the business context is in a continuous state of flux, and an underlying assumption is that each year may well bring new issues that managers should address.

The following sections describe the key elements of the module, explain the pedagogic theory underpinning the various elements, describe the evaluation methods and assess the key issues raised by this approach.

The Module Structure and Theoretical Underpinning

This section explains how pedagogic theory has been used in the design of this module.

The module combines lectures with team and individual assignments. Team working in theory and practice has become the fundamental theme and learning method of the module. It is the vehicle by which management theory (learnt in lecture and individual assignments) is applied. The application of management theory to manage the team tasks is as important to student learning as the tasks themselves.

The assignments—two individual and three team—represent a large part of the learning experience. The module is delivered to a cohort of 80 students. They are divided into 15 groups, and each group is in turn assigned to one of three tutors who were responsible for briefing and coaching the groups as well as also for marking group assignments. Group allocations are fixed, and groups are expected to spend their first few weeks consciously forming as a group and working out how best to operate collaboratively. To ensure that teams worked at a high level in those sessions in which student worked on assignments, the attendance is closely monitored and marks could be deducted even from marks assigned to a group if all the group

Table 3.1 Class sessions

Activity in class	Time spent (Number of sessions)
Lectures & guest speaker (a practising manager and serial entrepreneur)	3
Team work for the 3 team assignments	3.5
Briefing for assignments	1
Student presentations—use of all types of visual aids and use of a set of pre-prepared templates for PowerPoint presentations	1.5
Feedback; staff to student; student to staff; student to student—peer assessment	1.5
Discussion and review of the module elements between staff and students	0.5

members are not present. This structure places considerable demands on the tutors in checking and recording attendance, chasing up non attendees, and giving marks. It also demands a high level of engagement from students, who are expected to analyse their own and their colleagues' preferred management, communication, and learning approaches—for instance by completing online self-assessment questionnaires.

The assignments were designed around four topics: team management, thinkers and writers who had influenced management over the years, the institutions to be found in the City of London (which covered organisations as diverse as the Salvation Army, the Institute of Chartered Accountants, Smithfield Market, and Prudential Insurance) and an up-to-date case study developed on a company in the news. Students are expected to work outside the class sessions on their individual and team assignments and prepare for the exam. Supporting material is provided in the form of notes, slides, and core text book (Boddy 2008, 2011), distributed in class, and provided online via the course virtual learning environment (VLE).

Technology is used intensively to support learning within the module. The VLE is valuable as a tool for organising the wide range of materials used in the module, to provide a jumping-off point for other Internet resources, for submission of student work, for delivering the feedback on the assignments from tutors and as the main communication channel between students and staff.

There are 11 two-hour sessions and the use made of this time in the latest cycle of the module is shown in Table 3.1.

The teaching methods used were drawn from both the transmissive and the constructivist paradigms. The transmissive paradigm rests on the assumption that theoretical knowledge can best be imparted to students most effectively and quickly from an acknowledged expert (the lecturer). The lectures and set reading given by the module leader were designed to do this. The constructivist paradigm (Goodyear 2001) recognises that each group of students starts with some level of knowledge and that there is considerable scope for building upon this collectively to enhance the learning of the group as a whole. The key characteristic of the constructivist paradigm in this context is that it recognises the knowledge that such a diverse group

of students already possess when they start on the course and seeks to build upon this base. The assignments form a core component of the module and, together with the team work, offer students the opportunity to apply their knowledge pre-course and develop theoretical knowledge of management tasks to create their own understanding and interpretation of what is needed to become a successful manager. Hence we considered that the two paradigms—transmissive and constructivist—discharge complementary roles and we drew on both to form the theoretical framework for this module.

The pedagogic approaches adopted were influenced by the notions of non-formal learning (Eraut 2000), which deviate from the established didactic lecture style, but also typically assume some structure. Eraut's typology is based around a learners' *level of intention*, given that implicit learning, in his view the least formal type of learning, can take place without any conscious intention on the learner's part, and around *time of local event*, referring to when the learner received a particular stimulus.

Eraut adopts the term 'deliberative learning' to refer to the most structured level of non-formal learning, characterised by review of past experiences, engagement in decision making and problem solving, and planned learning goals and opportunities. Many components of the practice of management module fit well with this approach. He also uses the term 'reactive learning' to refer to learning based around 'incidental noting of facts' and preparedness for 'emergent learning opportunities'. The dérive within the practice of management module could be regarded as an example of reactive learning, and an aim of the module as a whole was to develop possibilities for reactive learning.

There are a variety of ways in which non-formal learning can be encouraged. The remaining part of this section outlines some of these ideas and explains how we put them to use in the module.

Because participants were expected to perform a variety of tasks and to reflect on these, pedagogic practice within the module was informed by enactive learning (Bopry 2005). This encompasses activities where students learn through doing, which is key to the module design. The aim of this module is to teach management theory and skills as well as the connection between them. Hence all the assignments are designed so that students need to practise skills such as working in a team, decision making under pressure and observation, which are important to practising managers. Furthermore, one aim of the degree programme was to develop the students' abilities as team workers and to exploit the benefits of operating within transient teams (Kester et al. 2007). Therefore, the team exercises were designed to prompt reflection among students into their own individual and team learning processes, consistent with the idea that students could form a community of inquiry (Garrison et al. 2000).

Frandsen (2006), writing about management education in response to established ideas of what should be taught within a traditional management programme, encouraged students to take ownership of part of a course. With this module, the structure was designed to quite a high level of detail but within the detailed elements of structure, the students were expected to take initiatives, to organise their own teamwork, and to reflect on the process.

Nicol (2007) considers formative assessment to be at the core of course design. He discusses how different assessment tools can be used with students at the start of their university career. Within the module, a large amount of time is spent by students on assessed activities, on which they are given both formative and summative feedback.

A particular response to the location in London is rooted in the concept of psychogeography, a concept that has proved an influence on a number of writers about London, notably Sinclair (2002) whose account of exploring the periphery of London on foot attained some popularity. One of the team exercises required groups of students to take a walk around the City of London using the principles of the *dérive* originating with Debord (1958), noting their observations and lessons that might be learned about the location. The emphasis in this exercise was on discovery and on the students' own construction of knowledge—this was deliberately set up as an exercise where students were not aware of the sort of issues and ideas that they might uncover in their dérive.

The results of applying the two paradigms and a variety of different pedagogic theories, mostly focused on the value non-formal learning, have led to the current structure of this module. Table 3.2 gives a theoretical framework on which the module is based.

This approach addresses the student problems of transition in a variety of ways:

- by offering a highly structured course with a series of well-defined tasks to be completed at various stages of the term
- by creating a community through the use of non-formal methods that put the students into situations that require interaction with each other and the tutors
- by creating a culture of attendance through the close monitoring of attendance at team exercises held in class time

It prepares students to take responsibility for managing their own learning in subsequent years of the degree course by developing their capability for reflection and self-assessment through the use of non-formal reactive and deliberative learning methods. It addresses the employers' demand for skills development through the use of non-formal deliberative learning methods which focus on skills. It addresses the problem of effective teaching of the subject of management through the combination of transmissive methods for knowledge acquisition and constructivist non-formal deliberative learning techniques which focus on the application of these theories.

The Process of Evaluation and Redesign

The module team (leader, co-designer, and additional tutors) review the module each year. The basic concept has been retained over several years but many elements have been refined or redesigned. This has been as a result of the team's own perceptions of problems, fine tuning of the original aims, feedback from each cohort of students and the comments and suggestions made by colleagues.

Table 3.2 Theoretical framework for—the practice of management

Theory	Description	Potential methods	Example activities in the module
Transmissive	Knowledge transferred to the Individual student from various sources	Formal lectures; guided reading; individual research, study and writing	Lectures on management theory; core text book; directed research for individual reports on management writers
Constructivist—non-formal reactive learning	Student Learning from his/her own past and current experiences, primarily through reflection and analysis of relatively unplanned activities (individual or team or class)	Review of past experiences through the lens of the theory relevant to the module. Analysis directed (by teachers) towards specific aspects of the experiences	Self-analysis through various diagnostics The dérive
	Development of the ability to learn from and build on all types of individual experiences as they are encountered in the future	Creation of opportunities for ideas/activities/contributions designed by students. Learning from the reflection and analysis of these activities the results of which are reported to the rest of the class	
Constructivist—non-formal deliberative learning	Student Learning from actively engaging in organised activities (individual or team or class) designed to support defined learning aims. Learning is a community endeavour involving teacher, class and individual, but is directed by the teacher. Students make use of past activities, as well as current exercises and learn to take control of planning their own future learning activities	Student exercises (individual, pairs, team and class) designed by the lecturer with a clear end point, focused on specific learning goals, specific skills and understanding of knowledge, within a well-defined structure. Feedback on each exercise with respect to the specific learning goals set out for the module	Active engagement in several activities—team exercises, reflective reports on team and individual performance. The series of team exercise build on each other to develop management skills and understanding of the application of management theory. Feedback sessions by students and staff

There are a number of channels for collecting feedback from the students on the modules—student evaluation forms at the end of the module, an online survey, informal comments to the tutors during the class activity sessions, use of a personal response system in the last session, emails to the course leader with questions, Q&A on the VLE site. Overall the student response to the module as recorded by questionnaires has been positive. Several saw it as being the core of what they had come to university to learn—for example one student introduced a very positive set of comments with a remark that 'this is a pure management module'. However a minority of students were uncomfortable with the level of reliance on students themselves to organise some activities, and a significant number would have welcomed more guidance on how to complete the assignments: an apparent paradox with this particular group is that they welcome the opportunity to carry out independent and self-directed work but they also demand a lot of assistance in exactly how to do this.

In this setting, there are further concerns associated with over-reliance on data from individual module questionnaires, notably that (particularly in a programme that includes a broad range of subjects) they can exacerbate a sense of different modules existing within separate 'silos' with little co-ordination between them, and that students' satisfaction at the end of a module is not necessarily a guide to how useful they find the learning.

Because the module is situated at the start of a three-year degree programme, and because it sets out to equip students with competences which they can use in later stages of their studies, it is both possible and appropriate to evaluate students' views of the module two years or more after it takes place. This counters a criticism of conventional student evaluation questionnaires, which ask students for their opinion at the end of the taught component of a module, and which fail to take into account any consideration of whether the module content can usefully be applied. One of the informal aims discussed earlier in this chapter was to induct students in approaches to learning that they would use throughout their undergraduate studies. Semi-structured interviews with students in their final year suggested that they had positive memories of this module and had found the management concepts covered very useful in subsequent parts of their course. They also noted that they were part of a very cohesive group, reflecting that this module had contributed to the creation of the community.

Other measures of success include:

a. Attendance and engagement. This has been particularly good among the last two cohorts, and also students' active contribution to class feedback sessions.
b. Quality of student feedback on the module. For the last cohort, the number of specific and relevant suggestions and comments that were made was particularly marked. These will be acted upon, and many originated in the clicker session which addresses more than just student satisfaction.
c. Quality of assignments and examination. This has improved over the last three years in terms of the quality, timeliness, structure and presentation of reports, the depth of reflection demonstrated and the degree of innovation, for example in presentations.

d. Cohesiveness of the group. This has continued and is particularly observable among the third year students who took the course two years previously.
e. Views from third year students.

Relating these to the formal aims of the module, the high level of student engagement means that they clearly find the module interesting, which is an important factor in learning. Knowledge of management theory, which is one of the formal aims, is tested very specifically in the assignments and in a subsequent examination. The interconnection of hard and soft tools runs through the various activities within the module. The individual and team working skills are tested by the assignments and also by the student feedback. Self and team reflection is built into the assignments and, again, the depth of the feedback and students' willingness to go beyond simply saying whether they were satisfied, is evidence of this reflection taking place.

Prompted by student responses, the third team exercise, which built on an earlier individual exercise on the theme of a management writer or guru, was unpopular and attracted significant negative feedback through several years. When the problem was presented to colleagues, their analysis suggested that the exercise was far too complex for first year students at this stage. The assignment has been simplified for the most recent delivery of the module.

Over the last few years, the session towards the end of the module conducted with a personal response system (electronic clickers which can be used for voting by an audience) has been of particular interest to the course designers (Beekes 2006). Questions are set by the course team and answers are anonymous from the student group who can choose 1 of 5 possible answers to any particular question (generally agree/disagree with various levels of strength). The most valuable result of these sessions has been the discussion generated from unexpected negative answers. For example, the response to the individual exercise 2 in which each student is given one management writer (guru) to research and write a report on was equivocal. Further discussion revealed two very interesting comments—that the choice of guru was very important as some have written so much that they seem difficult to pin down, others are perceived as of little immediate relevance to current business conditions and that the assignment could be done much better in pairs. The team intends to redesign this assignment as a result of this classroom discussion.

We expect continuing change to be an integral part of the module design, irrespective of the level of student satisfaction.

Issues Identified

Reflection on the most recent instance of the module and analysis of feedback from students pointed to a number of key issues for this and other modules that are taught in a similar way.

1. The module delivery can be seen as a succession of action research cycles. Action research presupposes a series of interventions—in this case successive course

design changes. However action research involves parallel activities—the development of theory and its application through an intervention in a practical situation. The interventions in this situation—course changes may be due to the application of newly acquired learning theory and/or attempts to improve the implementation of, for example, the operation of the assignments, so that the evaluation cannot easily differentiate between the success/weakness of theory and that of execution.

2. The number and pace of assessments and the level of guidance given for each assignment. The amount of guidance has been identified as a particular concern given that practical experience suggested that many students perceived a lack of guidance about how much time to spend on different exercises. As a result, each of the last few years has seen the development of further 'scaffolding' to clarify the requirements.
3. Evaluation of what has in fact been added to the student experience through the use of teamwork throughout the module. Freeman and McKenzie (2000) posit a set of questions to determine how well the team is functioning. For successful teams (which are assumed to add value) they would expect to observe the following behaviours:

   – Being punctual for team activities
   – Encouraging and allowing all team members to participate
   – Actively listening to others in the team
   – Understanding what is required
   – Level of enthusiasm
   – Effective informal coordination and formal coordination responsibilities

   At the start of the module, the theory of teamwork is introduced and considerable time and effort is devoted to make the teams work. For example, part of the briefing for students when asked—at an early stage, to reflect on different roles within their group—was a statement that they did not necessarily need a leader but would certainly need a coordinator within the group. In practice, most groups did take coordination seriously both at an organisational and a technical level, putting considerable effort into choosing what channels should be used for communication and what approach should be taken to arrange meetings. The tutors had some opportunities to gauge whether these behaviours were apparent during the class teamwork sessions. Over the last few cycles, the importance of attendance at team meetings has been increasingly emphasised. Tutorial support for team formation in the form of contacting non attendees has been extremely effective. In the majority of teams there were signs of teams working effectively, and in general students did carry their team working abilities into the subsequent stages of their degree programme.
4. Evaluation of the contribution of formative assessment within the module of both individuals and groups of student. A useful checklist for assessment in higher education provided by REAP (2006):

   – Do students actively engage with assessment criteria and standards?
   – Are there formal/informal opportunities for self- and peer-assessment processes?

- What kind of feedback is provided—does it help students to self-assess, self-correct?
- Are there opportunities for dialogue around assessment tasks?
- Does feedback focus students on learning and not just on their marks?
- Is feedback attended to and acted upon by students?
- How is feedback used to inform and shape teaching?

As the module has evolved, the assessment criteria have been defined more precisely, partly driven by an initiative to ensure more transparency and consistency of assessment standards across the university's undergraduate programme as a whole. In general students have taken a close interest in these criteria and produced work which meets the requirements. Some peer assessment is built into the module, although students are encouraged more to consider what roles and skills suit their colleagues than to rate other students on a scale. Feedback has, where possible, included constructive criticism and also highlighted where groups or individuals have done work of a particularly high quality. Because the assessment is formative, a priority has been to give feedback on one assignment before the next assignment is due. This also does encourage students to focus on learning and to take their feedback into account: It is less clear, at present, whether the feedback offered to students can shape teaching within this module at least.

5. How closely should we set out to emulate the real experiences which students are likely to encounter once they graduate and take on jobs within business? This addresses a point implicit in any type of learning through experience: Should the learning experience focus on creating a realistic experience for students comparable to one that they would encounter as managers or is it more valuable to provide an experience that may be contrived but presents the students with very particular issues in which there is some educational value in solving. The first category could be categorised as 'simulations' which aim to mimic the reality of working in a business as closely as possible. The second category could be better categorised as 'emulations' and would more closely describe the activities that comprise this module. Within the degree programme as a whole, simulations and emulations are regarded as complementary, but in the context of the first year and of the transition to university, the belief underpinning this module was that the greatest value sprung from using emulations to introduce students rapidly to business issues.
6. What potential exists for using emerging web 2.0 technologies, such as Blogs and Wikis, to support learning within the module? The potential for increased use of web 2.0 resources seems ever present. The university migration to a new VLE encouraged the team to specify in the latest cycle that student teams use wiki for one team assignment. Although use was erratic, this was considered by the team to be due to lack of adequate training in its use. This will be rectified in the next cycle.
7. What scope exists for applying non-formal learning in a way that suits the preferences and temperament of the current generation of students? There are some indications that this generation values individuality and would welcome a greater

measure of individualised learning. Members of this generation are very adept at dealing with use of information technology at a practical level, and we would expect the VLE to be used to support an increasing range of non-formal learning activities available online to support activities in class.

8. How could different approaches to learning—formal and non-formal, transmissive and constructivist be combined and for what purpose? This module is based around closely intertwined elements of all these methods. The subject (practice of management) and context (first year module for a management degree) has dictated the inclusion of non-formal methods, but the need to include theory has dictated the inclusion of a transmissive element. The use of all these methods has to be orchestrated carefully at an organisational level and entails a lot of preparation.

Implications for Innovation and Practice

This module is clearly valuable for students, who benefitted from the range of formal and non-formal learning components. The overall design has also proved adaptable, both in terms of accommodating a range of students with diverse background, and also in making it possible to build topical issues into the learning experience.

It is tempting to think of combining approaches to learning purely in terms of combining different channels, such as online and face-to-face contact with students. However the module discussed here is heavily focused on face-to-face interaction, as befits material intended for students attending a city centre university, but nevertheless uses a range of different tools which encompass both formal and non-formal learning. Combining face-to-face and electronic delivery of educational materials happens in many settings (in the instance discussed here, extensive supporting web resources were posted by the tutors), but both formal and non-formal learning methods can be used within both face-to-face and online approaches.

A number of factors contribute to successful implementation of this type of approach. These include:

- Commitment to action research does ensure that the module design is reviewed every year and also that the views of past cohorts have a direct effect on successive instances of the module.
- Devoting time and effort to designing the assignments as a central component of the module, and ensuring that they crystallise the essence of the subject being taught, in this case the practice of management.
- Ensuring that the delivery is well orchestrated and thoroughly planned.
- Facilitating effective teamwork by students.
- Using technology appropriately and to its full potential.

While some of the techniques used within this module will be familiar to many people working in management education, others—notably the dérive—are more esoteric and were chosen in this case because of their suitability for the City of London

setting. We would suggest that people working on comparable degree programmes, but in different locations or with different student sets, could benefit from this type of mix of approaches, but would need to identify a set of tools which is appropriate for their particular context.

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Chapter 4
Work-Based Learning Versus Work-Related Learning—An Exploration of the Possibilities of Work-Related Learning Through a Review of the Venture Matrix at Sheffield Hallam University, UK

David Laughton

Introduction

The role of work-based learning (WBL) in the development of student employability skills[1] is well researched (see, for example Bailey et al. 2004; Boud and Solomon 2001). WBL is seen as a powerful pedagogic approach in terms of bridging the gap between higher education and the world of work and providing real world, authentic learning experiences. In higher education in the recent period there has been an expansion in the number of forms in which WBL takes place: traditionally the placement or internship was the predominant form; however, this is now expanded by organisation-based projects, student consultancy, volunteering, on-campus employment linked to curriculum or course-based activities, and organising roles in student union events, to mention a few. Although universities have responded positively to both the opportunities and challenges of WBL in terms of linkages with the curriculum, accreditation and supporting processes, there is still a sense that demand outstrips supply for WBL opportunities in higher education. Many institutions, therefore, are offering work-related learning (WRL) as a substitute for WBL, when the latter is difficult to provide for in terms of curriculum match, resources available, and logistical necessities. There is no agreed and precise definition of WRL, but the approach adopted in this chapter is:

> learning which results in knowledge, skill or attribute development derived from engaging with tasks, processes and environments *similar* to those that occur in specific organisational and vocational contexts.

The chapter will review an approach to WRL within the "Venture Matrix" (VM) at Sheffield Hallam University in the UK. The VM offers a range of learning oppor-

[1] For a definition of employability skills see CBI (2009).

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tunities for students: group projects with employers, projects with Sheffield Hallam University as a public sector organisation, mentoring opportunities with school children in the region with the aim of facilitating their enterprise skills, and student group projects focused on entrepreneurial activities to identify value adding activities with market potential. It is the latter set of opportunities that will be investigated in this chapter. A focus group research method is adopted to generate data which are then subjected to content analysis to identify the nature of the skills and attributes students feel they have developed whilst participating in VM activity. The findings from the data are then discussed in the context of the literature on WBL and WRL to reflect on the similarities and differences in learning experienced in these different contexts. The recommendations of the chapter relate to the ways in which WRL is understood and configured to produce maximum benefit for those engaged.

Work-Related and Work-Based Learning

Margaryan (2008) suggests that the growth in interest in work-based learning (WBL) is linked with the need to re-think the notion of valid learning in the context of current challenges faced by organisations. These include increased global competition, the move from hierarchically based organisations to flatter and task/team-based structures, and the rapid development of information and communication technology. According to Nixon et al. (2006), WBL incorporates a process rather than a content driven curriculum, which is learner centred. Learning outcomes are agreed in a tripartite manner, involving learners, the school/college or university, and the relevant employer(s)/organisation(s). Learning is experiential in nature, self-directed, and underpinned by a critically reflective approach. Assessment of progress and achievements is evidence-based and often involves a mixture of learner (self), tutor, and employer judgements and comments. The nature of learning is characterised by it being (Nixon et al. 2006, p. 40):

1. Task-related—learning arises from performance of task in the workplace and tackling workplace problems or issues.
2. Innovative—new techniques and approaches are devised to meet new situations.
3. Autonomously managed and self-regulated—learning takes place without direct instruction or formal tuition; students are expected to take responsibility for their own learning.
4. Concerned with enhancing personal performance and improving organisational performance.

WBL then is clearly different from classroom-based, instructor dominated approaches to education focused on transmitting substantive knowledge of a factual, conceptual, and theoretical nature associated with a particular discipline, with the aim to allow learners to reproduce this (Raelin 2011). It is different with respect to the nature of knowledge developed and the pedagogical strategies required to support it.

WRL itself has a long history in a higher education context. It is a more wide-ranging and amorphous concept in contrast to WBL and is offered in a variety of delivery modes and educational programmes: professional courses (courses related to professional bodies), vocational educational provision in technical universities or universities of applied sciences (Laughton and Ottewill 1998), and programmes with a specific work focus, for example MBAs (see Byrkjeflot 2002, for a relevant discussion in this context). There is no agreed and precise definition of WRL, but the approach adopted in this chapter is:

> learning which results in knowledge, skill or attribute development derived from engaging with tasks, processes and environments *similar* to those that occur in specific organisational and vocational contexts.

The aim of WRL is to help to prepare learners for participation/employment in an organisational context by equipping them with relevant knowledge, skills, and attributes that can be used and applied in situ. However, a distinguishing feature of WRL, in relation to WBL, is that *it does not take place* in the workplace. WRL pedagogy has attempted to *simulate, replicate, or mimic* workplace situations or problems; however, the context of the learning experience (and hence any actual learning experienced) is different. Pedagogical approaches to WRL include the use of simulation, role play, and case studies/history. Case studies continue to be a defining feature of business education generally since being adopted as a major pedagogical practice by the Harvard Business School in the early part of the twentieth century. They are commonly used in the teaching of strategic management but can be found in almost every business discipline. Advocates comment positively on their incorporation and synthesis of real business problems and issues and the problem nature of the challenges to students to respond with solutions, decisions, and recommendations which mirror actual management practice. Aaronson, for example describes the case method as "probably as close to practical experience as one can give in the classroom" (Aaronson 1996, quoted in Mintzberg 2005, p. 51). Over the time, business educators have developed different types of cases (e.g. archival cases, documentary cases, living cases, and learner-generated cases) which have attempted to foster a wider and more complex range of skills such as creativity (Riordan et al. 2003). They are classed as a type of experiential learning (Thompson and Dass 2000, p. 28) and therefore, both useful and often superior to pedagogic approaches which emphasise the didactic transmission of propositional knowledge. Unsurprisingly, given the ubiquitous use of cases within business programmes, there has been intense scrutiny of and debate about the effectiveness of this approach in business education. Mintzberg (1975) is probably the most long-standing and strident critic in this context, proposing that a pedagogy based on the analysis and evaluation of cases continues to emphasise an inappropriately overly cognitive approach to management development, one that encourages a view of management as purely analysis and decision-making rather than the complex mix of art, science, and practice as he perceives it: "When cases are used in place of experience, devoid of history, and force people to take stands on issues they know little about, in my view they become a menace" (Mintzberg 2005, p. 60). The limitations of the case method are explored in all aspects of the business

discipline (Hiam 1990; Whetten and Cameron 1991, for example) with the debate on the role of this method within management education in particular showing few signs of subsiding.

There is considerable research on the use of simulations in an educational context (see Wolfe and Roge 1997, for a review). Computer-based simulations have been used since 1956–1957 in management education (Wolfe and Guth 1975) and were initially focused on the development and testing of technical skills (Stone and Dearing 2009). Whilst this continues to be an important focus of simulations, more recently there has been interest in using simulations to develop dynamic behavioural skills which are important in work contexts, for example leadership (Wood et al. 2009) and attributes deemed to underpin effectiveness in an organisational context and in life-long learning, for example self-efficacy (Thompson and Dass 2000). Attention has been focused on key design-elements of computer simulations to support learning: their structure, the surface of the simulation (the perceived world generated by sensory participation with the simulation), and associated or required tasks. Wood et al. (2009) suggest a hierarchy of four learning objectives that can be associated with computer simulations: (1) gaining insights, (2) acquisition of task-specific knowledge or expertise, (3) development of flexible expertise in applying task knowledge, and (4) the learning and transfer of behavioural skills. Thompson and Dass (2000) suggest that simulations have greater potential to foster self-efficacy skills amongst students compared to case studies for two particular reasons: firstly, simulations present better opportunities for students to develop "enactive master", deemed to be a key aspect of self-efficacy; and secondly, they are a better method for facilitating experiential learning.

Role play, as a form of experiential learning, has the potential to develop both subject knowledge and skills and competencies relevant to a particular vocational context. For Beard and Wilson:

> By means of dramatic activities students use and examine their present knowledge in order to induce new knowledge. (Beard and Wilson 2006, p. 142)

As those who participate in role play are actively involved in the construction of their own learning, role play can feature as the part of a constructivist pedagogy (rooted in the ideas of Vygotsky, see Van der Veer and Valsiner 1994), and offers the possibility of developing different intelligences (Gardner 1983). Dramatic role play is usually based on a dilemma, with participants acting out roles and contributing to possible ways of resolution. An interesting aspect of role play is the way in which it includes the emotional, affective, and ethical dimensions of experience and learning (see, for example Wootton and Stone 2010), and it has often been used in scenarios that feature negotiation, conflict, conflict resolution, and in the examination of culture and cross-cultural differences (Fowler 2009). Role play offers the possibility of both reflection-on-action and reflection-in-action (Schon 1983), where learners can experience the development of tacit and contextual knowledge which is a hallmark of professional knowledge. Claims have been made for the use of role play as an authentic learning tool (Clapper 2010), which both students and staff find enjoyable and rewarding (Van Ments 1999), and which can be superior in terms of outcomes to

the traditional lecture approach to education (Howard 2011). It is well established in disciplines such as medicine (e.g. doctor-patient etiquette) and law (e.g. law clinics) and can be found in the aspects of business pedagogy (see, for example Wootton and Stone 2010).

In summary, the following potential outcomes of WRL can be derived from the above review: the development of technical skills which underpin operational performance, behaviours, skills and attributes associated with successful task performance; an understanding of the integrated, interdisciplinary and dynamic nature of business problems; the ability to develop practical and workable responses to business problems and issues; an understanding of knowledge development through situated practice, reflection-on-action and reflection-in-action; the role of emotions in understanding and decision-making; and an appreciation of ethical aspects of organisational problems and issues. These characteristics are useful in helping to bridge the gap between the university curriculum and the world of work. However, in comparing WRL and WBL, many commentators believe that WBL offers a more powerful and valuable learning experience in this context. Although both approaches share the same general aspiration of equipping learners to be effective in an organisational context. Raelin (2008) argues that the pedagogy of WRL does not provide the same opportunities for learners to convert theory into tacit knowledge, learn how to challenge and reflect upon their own theoretical assumptions, defend decisions, assumptions and moral judgements under pressure, and experience the difficulties of obtaining co-operation within a task environment with competing priorities and perspectives. It therefore, produces different learning outcomes compared to WBL. These may be valuable in their own right, but their specificity and difference needs to be acknowledged within the context of curriculum and programme planning. An appropriate and important consideration in the context of designing learning opportunities that mirror the reality of organisational life is then *the extent to which WRL can be founded upon principles and designed in ways that produces outcomes that are as close as possible* to those identified in the WBL literature, given the importance of WBL in bridging the gap between the academy (universities) and the workplace (see, for example Nixon (2006); CBI/Universities UK 2009; Sas 2009). This is the primary focus of this chapter. In terms of principles, one possible way forward for WRL is suggested by the notion of "authentic learning" (Lombardi 2007). Authentic learning experiences are characterised as having the following features:

- Real-world relevance;
- Ill-defined problem;
- Sustained investigation;
- Multiple sources and perspectives;
- Collaboration;
- Reflection (metacognition);
- Interdisciplinary perspective;
- Integrated assessment;
- Multiple interpretations and outcomes.

Learning outcomes associated with authentic learning are perceived as having a high degree of relevance in a work-place context, as well as more broadly, for example as represented in the notion of active citizenship. One test of this view would be to evaluate the extent to which a WRL pedagogy based on the notion of authentic learning generates similar or overlapping outcomes compared to WBL as identified in the literature. It is this issue which is explored through the evaluation of a WRL intervention at a university in the UK.

The Venture Matrix

The development of the Venture Matrix (VM) within Sheffield Hallam University, UK, was the initiative of a number of academics who were interested in employability and enterprise education based on authentic learning principles. It offers a range of authentic learning opportunities for students: group projects with employers, projects with Sheffield Hallam University as a public sector organisation, mentoring opportunities with school children in the region with the aim of facilitating their enterprise skills, and student group projects focused on entrepreneurial activities to identify value adding activities with market potential (see, http://venturematrix.shu.ac.uk). It is the latter which form the focus of the research and investigation in this chapter. The scale of operations of VM has grown consistently over the last few years, and in 2010–2011 it is anticipated that 1,400 students will be involved. In summary, the student group projects engage students in the design and production of a good or service in response to either opportunities or tasks provided by outside clients (private, public, and social enterprises and charities), or those parts of opportunities or tasks which are sub-contracted from one student group to other student groups via a bidding or tendering process. There are a wide variety of products or services offered by the student groups, which help to create a vibrant internal market (student group to student group) and a virtual on-line trading estate for VM activities. The VM "world" is supported and organised by a currency/financial framework for measuring the value added by the group's activities (all groups—start out with a financial allowance in a notional currency—are able to supplement this by borrowing from a central bank at advertised rates of interest, and earn extra funds through the internal market which develop for group services provided). The group mechanism and value creation/value adding focus provides a work-related dynamic to the process, which supports participants in the development of employability skills and attributes. Examples of recent student groups and their self-stated activities and offers of services provided through the VM web site include:

Cutting Edge Media "We offer the best service in media. With a team of diverse, experienced, committed, and talented people, we will ensure that our service is a cut above the rest. We do: *Video editing *Photography *Posters *Flyers *Business Cards *Logos *Adverts *Graphic Designs *And much, MUCH more!!"

eXpert Management "eXpert Management" are running a development scheme within local schools in order to effectively encourage young individuals to enhance their sporting development & healthy lifestyle. We require other ventures (research and marketing experts) in order to fulfil this entrepreneurial opportunity. Our venture consists of four entrepreneurs who promote organisation, team working & desire to achieve the best!

Evaluation of the Student Experience of Venture Matrix

A previous evaluation of student learning via participation in the VM focused on students' personal understanding and assessment of achievements in relation to employability skills and competencies at the different stages of combined business and IT degrees (Clark and Myers 2010):

Teamwork;
Risk management;
Negotiating and influencing;
Effective communication;
Creativity and innovation;
Positive attitude;
Initiative and flexibility;
Organising and planning;
Problem solving;
Leadership/managing others;
Awareness of ethical issues;
Financial literacy;
Produce and service design.

A survey plus interview methodology was used to generate findings. Key findings were reported as follows:

> The students perceived that their 13 skill areas had been enhanced by 55–70% for first year students, by 65–81% for second year students and by 75–93% for final year students. Arguably the most striking feature is a monotonic enhancement of competences, from one year to the next in almost all the skills investigated. (Clark and Myers 2010, p. 31)

These findings were reassuring with respect to a range of employability skills. The skills included in the survey instrument, however, do not cover the range of WBL outcomes that appear in the relevant literature. To investigate this particular issue in more detail, a focus group session was organised. Five first year students from a Business and Technology degree course participated in this focus group, and the questions were themed around the central characteristics and outcomes of WBL identified by Raelin (2008) and Bailey (2004) which are summarised in the Appendix. The focus group discussion was recorded and transcribed. The transcription was then subjected to content analysis to identify key themes that emerged from the student reflections in relation to the organising framework for the discussion that was adopted.

The purpose of this approach was to produce data to help evaluate the extent to which the learning experiences and outcomes of their WRL were similar/dissimilar to those identified in the WBL literature, and hence to comment on the extent to which WRL can produce the same kind of experiences and outcomes as WBL. Summary findings from the focus group session are presented in Table 4.1.

Discussion

Participants were unanimous in their belief that the VM experience had helped them to develop their teamwork skills. They pointed to the strategies they adopted (dividing up work in relation to personal strengths, and meeting to check progress) and how they had developed confidence in dealing with people in group situations and in their communication skills. They recognised the different nature of what they had learnt through the VM process; although the participants struggled to articulate the nature of the skills/attributes/tacit knowledge they had developed, they made a clear distinction between this and the formal propositional knowledge they gained via class room instruction. They also made reference to the job-relatedness of what they had learnt, emphasising the value-in-use of this knowledge and its inherent link with the process of its creation.

There was evidence of groups having to change their plans and approaches as the year developed, and the accepted need for a flexible mindset in relation to securing opportunities from other VM groups. Individual responsibilities were allocated to individual group members, within a broad timeline, with work from other university modules being prioritised where deemed appropriate.

Participants found it difficult to identify any aspects of theory and knowledge developed in other modules that were drawn upon or transferred into the VM experience. Indeed, this appeared to be the case also with the supporting lectures that formed part of the academic module within which VM was embedded. Furthermore, there were few reflections on personal theories developed via the VM experience, although reference was made to "common sense" and how to get things done in the context of working with other people.

There was reflection on the emerging and organic nature of the task, and the way that participants had responded as the VM experience/process had developed. Some participants commented that the ways in which the groups had undertaken their tasks could have been improved, but there were no insights relating to the nature of individual versus collective viewpoints, the associated dynamic, and the implications for personal understanding. The VM experience as a whole was perceived as consensual within the groups, influenced by friendships, and therefore "laid back", which mediated the experience as a whole.

The participants emphasised the development of personal attributes above skills and knowledge, as a product of the VM experience. There was recognition of the workable and practical nature of their outputs, particularly in relation to the position

Table 4.1 Summary findings from the focus group session

Characteristics of WBL identified by Raelin (2008) and Bailey (2004) (see referencing/notation system used in the Appendix) and summary formulation	Evidence of these within the VM experience of students reported in the focus group discussion
1, 6, 7, b), f) "Collective processes/behavioural and practical outcomes"	"I'd say you do (develop team work skills) because when you get some work from a venture you all have to work together in order to get it done like on time and to the client specification so team working gets improved a lot." "Just getting on with each other, just recognising each other's skills and how to use them effectively in the piece of work that you're doing"
8, 9, e) "Problem orientation leads to lessons learnt"	"At the time, it doesn't really feel that you're learning, you obviously are but you just learn things as you go you might not realise that you're getting better at things like organisation, teamwork, and all sorts, might not necessarily realise just from doing the VM that you are." "It's like more psychological isn't it because when you go into a lecture you're actually going there to concentrate to learn, but when you do the VM jobs you're actually just there to do the job and get it done as best you can and you don't have to well you are actually learning interactively you're not actually learning factually, I think it helps"
3, a) "Real time learning experiences and problem formation"	"We just went with the flow to be honest until we actually needed to do some work and then we went for it." "Yeah we didn't realise like by the time we got to January the 21st when there was a trade fair we still hadn't got a job we'd been looking but everyone was like we're Nova finance they'd take our card but no one actually got back to us and then eventually when we'd set our sights on pretty much doing anything we managed to get a job quite easily it's just a case of getting in before was there an e mail I think there was an e mail on Bb and I think we must have got in first because we got jobs then I think there was one other group there when we got there two groups but we managed to get the job." "I think the best thing to do is to go into it with an open mind, if you go into it with a one track mind saying we're only taking this sort of work then you're not going to do as well..." "We really had to adapt to circumstance really"
2, h), j) "Autonomy and self direction with diverse thinking linking theory and real world experience"	"To be honest I didn't personally use any of the information out of the lectures I mean it was 9 o'clock start so I didn't turn up or most people who turned up were just sitting there tired out of their minds so to be honest I didn't really take much in I did take things in especially with some of the speakers that came in but the actual lectures themselves where it was just sitting there going through power points I didn't actually take in and as a result of that I couldn't really use it for the VM I just had we had to go with the skills we've got and develop from there..."

Table 4.1 (Continued)

Characteristics of WBL identified by Raelin (2008) and Bailey (2004) (see referencing/notation system used in the Appendix) and summary formulation	Evidence of these within the VM experience of students reported in the focus group discussion
	"I felt as a first year it was more common sense to get work and work with it, because you can't really do that much apart from just work for somebody else who has all the ideas and sets it all up for you so its more sort of getting in the right position to get some work."
	"Thing about our other modules is that they're not really to do with this so we couldn't really transfer"
4, i)	"I think we knew what the outcome had to be but the way we had to get to that outcome was quite open."
"Personal standpoints amidst a variety of organisational perspectives"	"I think coz we split like the work up into pieces say I'd do it one way and then someone else in the group would do it another way, we didn't really have many meetings like sat down together, so we found at the end of one task the work was a bit jumbled up coz we didn't take it like interpret it right I think I mean if we'd had more meetings maybe we'd have sorted it out more smoother but we tended to."
	"Like in our group we're all friends anyway so our communication was quite easy between us"
5, c), g), k)	"...Like I said I think its about attributes, like knowledge I didn't have to gain any knowledge I don't think I gained any knowledge in the end I think it's more about personal attributes."
"Workable and creative responses to organisational and environmental challenges"	"I'd say a mix of three (skills, knowledge and attributes) but mainly the personal attributes because I mean beforehand I wasn't very good at communicating like speaking to people I don't know but now I speak to people more confidently and interact better but I think knowledge and skills come into it as well, with the knowledge we did a research task for employability boosters so we researched into the website specifications standard website specs so I did gain a bit of knowledge on that and hopefully I'll be able to build my own website soon so put all that into practice like the legal side of it and the skills."
	"...don't really learn actual knowledge from it more what to actually do in certain situations..."

of their own work vis-à-vis the contracting VM group. The degree of creativity participants exhibited was seen to be limited as a consequence of undertaking work contracted by other groups. The feeling of being able to respond within situations given associated contingencies was also expressed and identified as a learning outcome of the VM process.

Conclusion

Participants in the focus group session were first year undergraduates. Engagement with the VM occurs in all three levels of their particular programme, and in different ways. As their programme progresses, the nature of the VM task becomes more complex and demanding, and student feedback indicates confidence in their employability skills development over time (Clark and Myers 2010). The focus group feedback undertaken in this study also suggests that there are a number of overlapping outcomes in the VM WRL experience compared to those that appear in the WBL literature: collective/team/group learning, personal attribute development (communication and team working), being responsive/flexible, defining problems/tasks, experience similar to what happens in organisations/the world of work, and the practical and workable nature of outputs. However, there were also certain WBL outcomes that were not achieved through the VM experience: the development of personal theories (above "common sense"), the application of theory to practice (and subsequent reflection upon its utility), and a broader understanding of the context of the tasks within organisational, cultural, and socially constructed relationships. The challenges and opportunities for educators in this context relate to the extent to which these aspects can be integrated within specific WRL opportunities. Reflective pedagogy is both increasingly understood and used in a higher education context (Moon 2004) and curriculum designers can draw upon this research and these insights to add a reflective dimension to WRL activities and encourage the development of personal theories. Applying theory to practice continues to be a challenge for many students (Little and Harvey 2006). Laughton (2011), makes a number of suggestions in this context: an approach based on generating theory from business-related experience and practice as a way of introducing students to the theory-practice nexus in business education; the development of "live cases" based on students' organisational experience that can be used in the class room; and inviting students who have undertaken WBL to deliver specific inputs into learning sessions. Encouraging students to develop a broader understanding of the (social) context of their tasks can again be encouraged through a specific focus on this aspect in the design of the learning activity, and curriculum developers can take inspiration from the action research literature in this respect (Carr and Kemmis 1986). By focusing on such issues, curriculum developers can enhance the power of WRL to facilitate learning outcomes that support both the employability and life-long learning attributes.

Appendix

Key Outcomes of Work-Based Learning:

1. Learners learn collectively by working on and then reflecting on actual "actions" occurring in a real work setting.
2. There is a merger of theoretical principles with an understanding of the social construction of the organisations in which the learners work.
3. Real-time experience and problems occurring within a work setting, form the substantive subject of learning lesson.
4. Feedback focusing on learners' values and behaviour ensures that actions are seen as positions/points of view with anticipated consequences.
5. Learners are forced to find real, workable answers, not easy, hypothetical ones.
6. Leadership and teamwork skills are developed along with more technical skills.
7. There is immediate benefit to the organisation from the learners' contribution to the project.
8. The lessons learned from the experience tend to stay longer with the learners than if they had learned them from a book or lecture.
9. Dissolving problems rather than solving them is the primary focus and outcome.

(Adapted from Raelin 2008, pp. 84–85).

a. The cognitive skill of problem formation.
b. Flexible modes of problem solution—WBL students often learn that different solutions are sometimes appropriate for the "same" problem.
c. Using the environment as part of the problem resolving system—exploit the context creatively.
d. Effort saving, which helps with problem definition and the development of skills to solve these.
e. Application/adoption of a variety of forms of representation with respect to problems.
f. Cognitive teamwork—outcomes associated with the interplay of inputs from team members.
g. Executive functions—autonomy and self-direction.
h. Higher order thinking, characteristic of the discipline.
i. Understanding social relations within the context of the labour process.
j. Exposure/experience of diverse modes of thought.
k. Educational institution—work dialectic encouraging new ways of thinking.

(Adapted from Bailey 2004).

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Part II
Workplace Learning

Chapter 5
What Keeps Low- and High-Qualified Workers Competitive: Exploring the Influence of Job Characteristics and Self-Directed Learning Orientation on Work-Related Learning

David Gijbels, Isabel Raemdonck, Dries Vervecken and Jonas Van Herck

Introduction

In today's rapidly evolving society, we are confronted with an exponential increase in information, a growing need for innovation and the requirement to develop sufficient skills. Schools, enterprises and players in the field of training and development are faced with the challenge of finding, valuing and further developing every talent. Teaching and training in the workplace is one of the most important tools for improving the difficult connection between education and the labour market. As a result, the value which is placed upon learning in the workplace has increased. Everyday work practice is full of potential learning processes. These can be very effective and necessary for the purpose of developing an expertise in a profession. Learning often takes place without one being aware of it, by making mistakes and redoing, talking with colleagues, observing, reading and listening to others. How such a powerful learning work environment can be created is a matter for which educators and HRD professionals are responsible. However, it is not just a quality work environment which is of importance; equally important is how the individual copes with successive changes. In this paper, we want to further enlarge our understanding of the factors explaining work-related learning. We will do this by means of presenting a research model that

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has been investigated with both low—and high-qualified people in two different contexts: the context of learning at work in part-time vocational education (low-qualified people lacking a diploma secondary education) on the one hand and ICT-workers in a large company (high-qualified people with at least a bachelor diploma) on the other hand. In research practice on work-related learning, most studies to date focus on high-qualified people. A focus on both high-qualified and low-qualified people is relevant as the research model might count for one group of employees but not for another group. First, the characteristics of the work setting might be different for low- and high-qualified people. Previous research demonstrated that the access to and facilitation of work-related learning has been unevenly distributed and is primarily in favour of possession of prior qualifications. The work context, in which low-qualified employees are working, might not stimulate work-related learning. Therefore, in both samples a variety of work contexts were assured. Second, as the work environment of low-qualified employees is not always favourable for learning, the individual characteristics might be more important in the prediction of work-related learning of low-qualified people. In the next paragraphs, we discuss the most important variables in the research model and end our introduction with a description of the model.

Job Characteristics and Work-Related Learning

The characteristics of the work which is done determine the quality of learning at the workplace. From the literature, it is apparent that job characteristics such as job demands and job control are related to negative outcomes such as tension, work stress and dissatisfaction with work (e.g. De Jonge et al. 2003). Recently, research has also been conducted on job characteristics as determinants of positive outcomes such as well-being (De Jonge et al. 2000; Dollard et al. 2000; Landsbergis et al. 1992; Taris and Schreurs 2009, Van Mierlo et al. 2007), commitment (Demerouti et al. 2001) and learning behaviour (Daniels et al. 2010; Parker and Sprigg 1999; Skule 2004). Insight into the role of job characteristics is, therefore, of great importance. Karasek's demand-control (DC) model and the derived demand-control-support (DCS) model are leading *theoretical models* in research into the psychology of work (Panari et al. 2010; Taris et al. 2003). The DC model assumes that a work environment can be described in two dimensions: Job demands on the one hand and job control on the other (see Fig. 5.1).

Job demands (horizontal axis) refer to the physical and mental efforts involved in the work, specifically that a large volume of work is to be performed under conditions of high requirements and time constraints. Job control (vertical axis) refers to the worker's control over his or her work processes, in other words, the ability to make decisions and the opportunity to exercise a degree of control over the work to be carried out oneself in order to satisfy these job demands.

A third dimension has been added over time by Johnson and Hall (1988): *work-related social support*. This means the existence of good relations with colleagues,

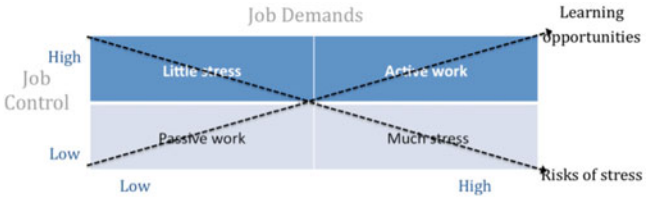

Fig. 5.1 The demand-control model (based on Karasek 1979)

being able to rely on others, obtaining accurate information via others and gaining actual help, understanding and attention when difficulties are encountered (De Jonge et al. 2003). The most favourable effects *on work-related learning* are expected with a combination of high (but not overwhelming) job demands, high job control and high social support (also known as Karasek's learning hypothesis).

A Self-directed Learning Orientation and Work-Related Learning

The development and fruition of the knowledge economy and numerous technological changes not only require more highly trained workforces, modern employees are also expected to be willing to continue to learn. The notion of lifelong learning has become generally accepted. An attitude of continual learning requires an orientation towards self-direction and flexibility. A self-directed learning orientation is defined as a relatively stable tendency to take an active and self-starting approach to work-related learning activities and situations and to persist in overcoming barriers and setbacks (Raemdonck et al. 2008). Employees with a pronounced self-directed learning orientation identify learning opportunities, show learning initiative, undertake learning activities and persevere in overcoming barriers to learn. In contrast, people who are less oriented towards self-directed learning exhibit the opposite behaviour: they fail to identify learning opportunities, let alone seize opportunities to learn (Seibert et al. 2001). As self-directed learning orientation is found in persons who actively shape learning activities and situations, we expect employees with a self-directed learning orientation to exhibit more actual work-related learning.

We state that a self-directed learning orientation is important for every job at every level in the present knowledge society. In *the present chapter* we want to examine the importance of both work-related variables (such as job demands, job control and social support at work) and the person-related variable "self-directed learning orientation" for explaining work-related learning *in different work settings*. We will illustrate our statement by means of a research in two different contexts of workplace learning: the context of learning at work in part-time vocational education on the one hand and ICT-workers in a large company on the other hand. Our study is based upon the learning hypothesis from the DCS model (Johnson and Hall 1988; Karasek 1979; Karasek and Theorell 1990) and the research by Raemdonck (2006).

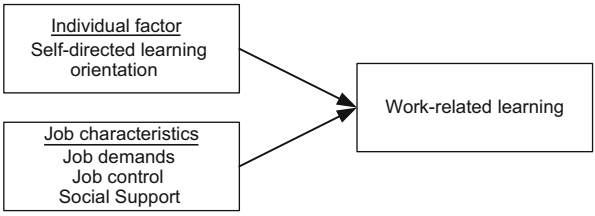

Fig. 5.2 Research model: Determinants of work-related learning

The aim of our study is to investigate the influence of job-characteristics such as job demands, job control, social support at work on the one hand and self-directed learning orientation on the other hand on the work-related learning behaviour of both high- and low-qualified people at work (see Fig. 5.2).

Present Lacunae Regarding the Active Learning Hypothesis

Even though current management philosophies emphasise the importance of having self-managing and development-orientated employees (Parker and Sprigg 1999), this learning hypothesis has received surprisingly sparse attention (De Lange et al. 2003; Taris and Kompier 2005). Although some support for the active learning hypothesis can be found in current research literature (Bond and Flaxman 2006; Demerouti et al. 2001; De Witte et al. 2007; Parker and Sprigg 1999), these results are far from convincing since many studies suffered methodological and conceptual weaknesses (Taris and Kompier 2005). This study addresses three shortcomings in specific: (1) measurement of learning, (2) lack of taking personal characteristics into account and (3) homogenous sampling.

1. Most of the studies in the past which were aimed to test the learning hypothesis used rather distant outcome variables such as "job satisfaction" or "commitment". Therefore the results obtained from these studies can hardly be considered as a validation for the learning hypothesis (Taris and Kompier 2005). The central focus of the present study is to test the learning hypothesis with a criterion variable which reflects the nature of active learning more directly: work-related learning behaviour.
2. The DCS model has both been praised as well as criticized for its simplicity. It focuses only on characteristics from the work environment and neglects the intrapersonal psychological processes at work between job characteristics and learning behaviour. It is however very likely that highly motivated people choose challenging, learnful jobs (e.g. high demands, high control) and people with low motivation to learn pick a job according to their preferences (e.g. low demands, low control). Pomaki et al. (2004) suggested that the degree to which workers posses self-regulatory abilities influence their development of competencies. This could imply that self-regulation mediates the influence of job characteristics and learning behaviour. Past research often failed to address this reciprocal

relationship between job characteristics and personal characteristics such as self-regulation abilities (Taris and Kompier 2005). The present study tries to shed light on this unexplored relationship by including the construct of self-directed learning orientation and analysing their mutual influence on work-related learning behaviour.
3. When trying to validate the active learning hypothesis, it is important to test its assumptions on different kinds of worker groups. Since the hypothesis has often been tested with professions where direct interaction with other people is an essential part of the job (e.g. police officers, teachers, nurses, cashiers) there is a need to draw upon other, more heterogeneous samples (Taris and Kompier 2005). The present study aims to address these current Lacunae.

Research Questions

The aim of this study is to examine the relation between the independent variables of a self-directed learning orientation, job demands, job control and job support and the dependent variable of work-related learning behaviour. The following *research questions* are central to this:

1. Is self-directed learning orientation positively related to work-related learning?
2. Are job demands positively related to work-related learning?
3. Is job control positively related to work-related learning?
4. Is social support positively related to work-related learning?
5. Is a high score for self-directed learning in combination with high job demands, high job control and high social support favourable to work-related learning?

Method

Two cross-sectional studies, using the same questionnaires were carried out to find answers on the research questions. Two samples with interesting differences and similarities were selected. Learning on the job is a necessity in both sectors: in vocational education there is hardly time at school for students to learn all knowledge skills and attitudes relevant for their future work and the IT sector is one of the most fast developing sectors where its workers have to constantly keep themselves updated in order to stay competitive. The big difference between the samples lies in the qualifications of the workers: vocational students have no secondary school diploma and all IT workers had at least a bachelor diploma.

Measures

Already *validated questionnaires* for measuring the four independent variables were administered in both the context of learning at work in part-time vocational education and the context of ICT-workers in a large company. In the next paragraphs, we will discuss the research instruments that we used to measure the variables that are included in our research model.

Job Characteristics For the measurement of the DCS characteristics, we selected items from existing questionnaires of De Jonge et al. (1994), Hackman and Oldham (1975), Karasek (1985), and Warr (1990). The three characteristics are measured using five-point Likert scales, which range from 1 for strongly disagree to 5 for strongly agree. Job control is measured using a scale that consists of 10 items. Only the aspect "decision authority" is measured here (see above). This is the amount of say an employee has in his job. The respondent is asked about the extent to which the job that the students perform at their learning workplace provides them with the opportunity to "stop working when they like" or "to determine their own way of working". Job demands are measured by means of 11 items and refer to statements such as "My job requires that I work very hard", while questions are asked about social support on the basis of 5 items such as the statement "I receive much support from my colleagues".

Self-Directed Learning Orientation The self-directed learning orientation scale is an 11-item scale developed on the basis of the short version of the Proactive Personality Scale of Bateman and Crant (1993) and the Personal Initiative Scale of Frese et al. (1997). Empirical evidence demonstrates that self-directed learning orientation is a uni-dimensional construct (see Raemdonck 2006). Examples of items are "A difficult task does not hold me back" and "I am constantly looking for new ways of improving my job performance". Participants were asked to indicate on a five-point scale (ranging from 1 = strongly disagree to 5 = strongly agree) to what extent each statement was applicable to them.

Work-Related Learning It is measured on the basis of a self-developed instrument. In 10 items, the respondents were asked about the frequency with which they had actually participated in certain work-related learning activities during the past year, for example, the acquisition of new information, the finding of solutions to problems and the performance of new tasks. This is measured on a four-point scale ranging from 1 (almost) never to 4 (almost) always. An exploratory factor analysis, with the main components extraction and Varimax rotation for the 10 items en masse, showed that all items loaded on one and the same factor which explained circa 40% of variance. Factor loadings for the 10 manifest variables ranged from 0.580 to 0.731. Also content wise, these 10 items such as "learning new things", "creating new ideas", "looking for new information", seem to reflect several aspects of work-related learning behaviour.

Analyses

Correlation analysis and multiple regressions were applied to analyse the research model. Interaction terms were built with centred predictor variables to optimize interpretability and minimize multicollinearity (Aiken and West 1991).

Results

Study 1 (Gijbels et al. 2010)

Respondents

The questionnaires were administered to students ($N = 115$) from three schools providing part-time education. As not all students from the part-time secondary vocational education have jobs, only students who had a job contract as part of their training were questioned for the study. The questionnaire was administered by one member of the research team during class. The completion of the questionnaires was always preceded by an introductory talk. The study includes students from the different training "rubrics" which are offered by the Flemish part-time educational system: woodwork (9.6%), catering industry (10.5%), metal industry (10.5%), business and administration (7.8%). Participants represented several training sectors (e.g. Assistant cook, kitchen staff within catering rubric) from which the rubrics are composed. The age of the respondents, ranged from 15 to 22 ($M = 16.8$, $SD = 9$). Furthermore, young workers are in a stage where they are adapting themselves to the world of work so that the influence of work characteristics on learning behaviour is presumably different as for experienced workers. The young workers are at a stage in life, in which the expansion in competencies through work is at its largest (Borghans et al. 2006).

Descriptives

There was a noticeably high score for the personal characteristic "self-directed learning orientation" (see Table 5.1). With regard to the job characteristics, it is noticeable that social support at work gets a high score. Students often state that they "receive support from their colleagues to get their work done". Mutual relations between colleagues are good and their superiors appear to be an encouraging influence in many cases. It appears that the average student from the part-time vocational education sector does not have a great say (job control) in his work tasks. With an average of 2.69 for control on a scale ranging from 1 to 5, the half-way mark is not reached. Most respondents are of the opinion that they have few opportunities to determine the nature of the work and the amount of work over a particular period. The job

Table 5.1 Averages, reliability, standard deviations and number of items per scale (study 1)

Variables	Mean	α	*SD*	Number of items
Job demands	3.30	0.72	0.58	11
Job control	2.69	0.79	0.69	10
Social Support	3.98	0.79	0.73	5
Self-directed learning orientation	3.74	0.83	0.54	11
Work-related learning	2.55	0.83	0.49	10

Table 5.2 Correlations between four independent variables and work-related learning (study 1)

	Self-directed learning orientation	Job demands	Job control	Social support	Work-related learning
Self-directed learning orientation	1	411**	197*	317**	317**
Job demands	–	1	0.053	0.316**	287*
Job control	–	–	1	0.218*	0.122
Social support	–	–	–	1	0.122
Work-related learning	–	–	–	–	1

*significant correlation ($p < 0.05$, two-tailed)
**significant correlation ($p < 0.01$, two-tailed)

demands tend to be rather high in view of the students. This characteristic obtains an average score that lies just above the median (3.30 on a scale of 1 to 5).

It is apparent from the correlations in Table 5.2 that two independent variables correlate in a significant and positive way with the dependent variable of work-related learning behaviour: self-directed learning orientation and job demands. The independent variables of "job control" and "social support" are not significantly correlated with the dependent variable of "work-related learning". Furthermore, Table 5.2 shows that "self-directed learning orientation" and "job demands", "self-directed learning orientation" and "social support", and "job demands" and "social support" are significantly correlated with each other. These correlations are also positive and moderate to strong (between 0.30 and 0.50; Cohen 1988).

Predictors of Work-Related Learning

A multiple regression has been carried out in order to discover what influence the job characteristics and self-directed learning orientation have on work-related learning behaviour. In Table 5.3, the standardised regression weightings for the four independent variables are included. These relate to the three job characteristics of job demands, job control and social support and the personal characteristic of self-directed learning orientation. These constitute the main model as shown in Fig. 5.2. Participants' sex was also included as control variable.

Table 5.3 Standardised regression weightings for work-related learning (study 1)

	Beta
Self-directed learning orientation	0.424*
Job demands	0.139
Job control	0.087
Social support	−0.064
Sex (dummy)	0.085
R^2	0.241*

*$p < 0.05$

This main model is able to explain 21.2% of the variance within work-related learning, as can be seen in Table 5.3. Self-directed learning orientation appears to be the greatest and only significant predictor of work-related learning. An increase of one point on the scale of self-directed learning orientation is associated with an increase of 0.393 on the scale for work-related learning. From this analysis, the job characteristics (demands, control and support) appear to have no significant positive influence on work-related learning behaviour.

Compared with the variable of self-directed learning orientation, the influence of the job characteristics is rather modest and not significant. Noticeable is the small negative effect of social support on work-related learning. The support that students receive from their colleagues appears not to stimulate their work-related learning in the learning workplace. The effects of job demands and job control are certainly positive, but not significant with regard to work-related learning. The influence of job demands (e.g. time pressure) is greater than the effect of job control (e.g. taking decisions oneself) over work-related learning. Participant sex had no significant influence on the work-related behaviour.

According to Karasek's DCS model, active learning behaviour probably occurs more frequently in work situations that combine high demands, much control and much social support. In order to explore this hypothesis, interaction terms are added to the main model. None of these added interactions appears to exert a significant influence over work-related learning. The outcome of this analysis is presented in Table 5.4.

Study 2 (Gijbels et al. 2012)

Respondents

The questionnaires were administered online to employees working at Kluwer Technology Solutions (KTS). KTS is part of Kluwer Belgium, a leader in information services for professionals in different areas. A total of 73 participants responded to the questionnaire (response rate of 52%). Male participants were 73% whereas 27% were female. The age of the participants varied between 20 and 51 years ($M = 36.2$, $SD = 7.2$).

Table 5.4 Standardised regression weightings for work-related learning with two- and three-way interactions (study 1)

	Beta
Self-directed learning orientation	0.369*
Job demands	0.132
Job control	0.112
Social support	0.005
Job demands × Job control	0.164
Job demands × Social support	0.008
Job demands × Job control × Social support	−0.006
Job control × Social support	0.010
R^2	0.258*

Variables are centred
*$p < 0.05$

Table 5.5 Averages, reliability, standard deviations and number of items per scale (study 2)

Variables	Mean	α	*SD*	Number of items
Job demands	3.63	0.811	0.529	11
Job control	3.23	0.868	0.683	10
Social support	3.56	0.788	0.661	5
Self-directed learning orientation	3.74	0.832	0.460	11
Work-related learning	2.86	0.918	0.555	10

Descriptives

There was a noticeably high score ($M = 3.74$) for the personal characteristic "self-directed learning orientation" among the participants from KTS (see Table 5.5). The employees strongly agreed on items such as: "A hard to solve work task doesn't stop me" and "I am always looking for better ways to fulfill my work duties". With regard to the job characteristics, it is noticeable that job demands get the highest score ($M = 3.63$) in combination with the smallest standard deviation (0.53). Employees strongly agreed on items such as: "My job demands a high degree of concentration and accuracy" and "I need to perform a lot of mental work". At the same time, by giving items like "my work offers the possibility to choose my own way of working" high scores, they report being able to exert quite a degree of job control ($M = 3.23$) over their work tasks. With an average of 3.56 for social support, the employees agree to have collegial support on the job when problems or questions occur.

It is apparent from the correlation in Table 5.6 that two independent job characteristic variables correlate in a significant ($p < 0.01$) and positive way with the dependent variable of work-related learning behaviour: "job demands" and "job control". The independent variable "social support" is not significantly correlated with the dependent variable of "work-related learning". The personal characteristic "self-directed learning orientation" correlates with 0.612 positively with the dependent variable of work-related learning. This correlation is significant on the 0.01 level and can be interpreted as strong (Cohen 1988).

Table 5.6 Correlations between four independent variables and work-related learning (study 2)

	Self-directed learning orientation	Job demands	Job control	Social support	Work-related learning
Self-directed learning orientation	1	0.220	0.333**	0.134	0.612**
Job demands	–	1	293*	0.015	0.334**
Job control	–	–	1	0.149	0.357**
Social support	–	–	–	1	0.052
Work-related learning	–	–		–	1

*significant correlation ($p < 0.05$, two-tailed)
**significant correlation ($p < 0.01$, two-tailed)

Table 5.7 Standardised regression weightings for work-related learning (study 2)

	Beta
Self-directed learning orientation	0.532*
Job demands	0.178
Job control	0.133
Social support	−0.033
Sex (dummy)	0.018
R^2	0.429*

Variables are centred
*$p < 0.05$

Furthermore, Table 5.6 shows that "self-directed learning orientation and job control" and "job demands and job control" are significantly correlated with each other. These positive correlations are moderate (around 0.30).

Predictors of Work-Related Learning

The prediction of work-related learning was tested using the enter method of a multiple regression analysis. The model with four independent variables clears of 42.9 of variance of work-related learning. Based on our results, the job demands, job control, social support are no significant predictors for work-related learning. Self-directed learning orientation seems to be the only significant predictor for work-related learning. The standardised regression coefficient (Beta) for self-directed learning orientation is 0.534. Table 5.7 shows results from multiple regression analysis for work-related learning.

Interaction terms are added to the main model to explore Karasek's suggestion that active learning behaviour especially occurs in work situations that combine high demands, much control and much social support. Results exposed a significant negative two-way interaction between job demands and social support on work-related learning behaviour. It seems that the combination of high demands and much social

Table 5.8 Standardised regression weightings for work-related learning with two- and three-way interactions (study 1)

	Beta
Self-directed learning orientation	0.555*
Job demands	0.148
Job control	0.097
Social support	−0.061
Job demands × Job control	0.062
Job demands × Social support	−0.233*
Job demands × Job control × Social support	0.234
Job control × Social support	−0.003
R^2	0.494*

Variables are centred
*$p < 0.05$

support results in lower degrees of work-related learning behaviour. The outcome of this analysis is presented in Table 5.8.

In order to sharpen our understanding regarding this significant interaction, we followed the guidelines provided by Cohen and Cohen (1983) and Aiken and West (1991): we plotted three simple regression lines of the regression of work-related learning on degree of job demands as a function of three values of social support, high (+ 1*SD*), mean and low (−1*SD*) (see Fig. 5.3). Lowest degrees of work-related learning were indicated by participants who stated facing high job demands and much social support: this finding was significantly different from zero, ($\beta = -0.51$), $t(74) = -2.3$, $p = 0.028$. Highest degrees of work-related learning were reported by participants who indicated to have low job demands and high social support: this finding was significantly different from zero, ($\beta = -0.43$), $t(74) = -2.3$, $p = 0.028$.

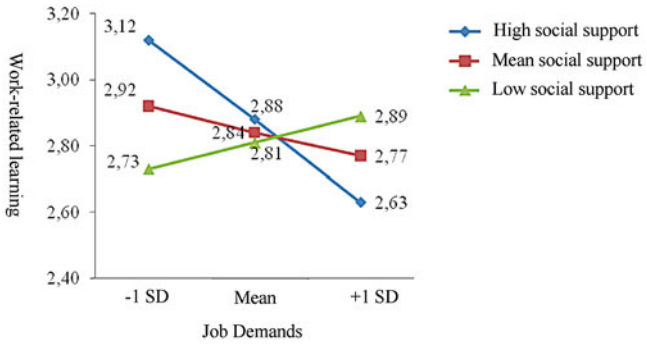

Fig. 5.3 Interactions between job demands and social support on work-related learning plotted from centred variables

Conclusions

Discussion Results

With these two studies, we aim to fill a current lacuna regarding the active learning hypothesis as proposed in the JDCS model from Karasek by means of questionnaires with work-related learning behaviour as the criterion variable and including self-directed learning orientation as a personal characteristic.

Both the results from the part-time vocational students and the KTS-employees point in the same direction: Self-directed learning orientation, regardless of participants' sex, seems to play the most important role for both the (low qualified) students in part-time vocational education and the (high qualified) KTS-employees in explaining work-related learning. When taking the self-directed learning orientation of workers into account, no link could be established between job characteristics of the workplace and the work-related learning of students from the part-time vocational education sector and of ICT-employees working within an information service company. This is not what we expected. The assumption, based on the learning hypothesis of Karasek, was that high demands from the learning work environment, many opportunities for control over work tasks and much social support would at least also show a positive link with work-related learning. However, on the basis of the study results, taking the self-directed learning orientation of workers into account, these three (job demands, job control and social support) do not appear to have a significant positive influence in both studies and the learning hypothesis is challenged once again. An interesting finding is the statistical significant interaction effect between demands and social support. According to the learning hypothesis, higher demands in combination with more social support would lead to an increase in learning behaviour. However, our results indicate that this combination rather leads to a decrease in learning behaviour for IT workers. It seems that IT workers who report to have high work demands and strong social support rather use these support to let them do the work for them or to passively adopt the provided help rather than using this potential to learn from and with each other.

The significant positive influence of a self-directed learning orientation confirms the expectation that individuals who are highly self-directed in their orientation towards learning also actually learn more in a work-related way independent of their qualification level. Consequently, it is important to develop the self-directability of students and employees. In this way, this population of students and employees can also acquire skills that can result in higher employability as well as organisational success (Guglielmino and Guglielmino 1994; Raemdonck and Thijssen 2005; Van Loo 2005). Our study shows that the work-related learning of students in vocational education and ICT-workers relies on their personal characteristics. In future, it would be wise to explore the role of such personal characteristics in work-related learning further as well as to look for possibilities for developing these personal characteristics at school and on-the-job learning. Both for high- and low-qualified people, investing

in the development of a self-directed learning orientation seems to be important for enhancing learning at work.

Limitations

Several limitations of the studies are worth mentioning. First, a cross-sectional design was used in both studies. Potentially interesting questions regarding development over the time of work-related learning were not able to be addressed (Taris et al. 2003). A longitudinal follow-up of the respondents would allow making causal relationships regarding the influence of interpersonal variables and job characteristics on work-related learning. In follow-up research, it would also be interesting to look at self-directed learning orientation as a mediating rather than an independent variable.

Second, all variables measured in the research studies were obtained through self-report. The magnitude of the effects reported may have been biased due to common-method variance.

Third, the current studies involved a sample of students from only three schools in the vocational education sector in one region and a sample of ICT-workers from one large company, so both samples were more or less homogeneous. Future research should test the research model with more non-homogeneous samples and should not solely rely on self-reports. Learning behaviour can be assessed by the supervisor.

Fourth, we choose only one type of learning (work-related learning behaviour) as the criterion variable to answer the call to choose variables which reflect the true nature of active learning more closely as has been done in the past (Taris and Kompier 2005). However, since different types of learning can be distinguished (e.g. informal versus formal learning), it is plausible that different forms of learning may be more influenced by JDCS model. Future research could bring insight on this issue.

Implications for the Practice of Workplace Learning both in Education and at Work

Despite the limitations of the present study, some important implications can be drawn. The highest levels of work-related learning are found in those students and employees who show a high orientation towards self-directedness in learning. Therefore, the stimulation of self-directed learning orientation should be maximised in the workplace and at school. Better information regarding "learning on the job" can be made available to students, workers and managers of employing organisations as a result of a greater co-operation with vocational education and training providers. The provision of the part-time vocational education and (internal or external) training can also be more focused on the teaching and development of this self-directed learning competence, including learning how to learn.

From the results, it appears that students from the part-time vocational education sector and the ICT-employees on average attribute high scores to social support. They are of the opinion that they receive a great deal of support. Despite the support they receive in the workplace, this does not appear to have the effect of stimulating work-related learning. There is a risk of students and employees developing undesirable action plans as a result of "wrong support" (Taris 2007). Therefore, "negative" social support should be prevented. In this way, one can minimise the negative effects of it on workplace learning. It would appear desirable to look for systems which enable students and employees to receive and give "accurate feedback" at times when this is necessary. In this way, students and employees can further develop "appropriate action plans". For this, clear agreements and co-operation is essential.

Our findings suggest little support for the views of Karasek and Theorell for students in part-time vocational education and in ICT-workers when the self-directed learning orientation of the workers is also taken into account. The beneficial effects of high job demands, high job control and high social support were not confirmed in our analyses. Instead, a self-directed learning orientation was clearly associated with higher levels of work-related learning. It would be interesting to see whether these results can be replicated beyond the context of part-time vocational education and within other professions than ICT-workers. Future longitudinal studies will have to verify the results found in this study. The results point to the importance of self-directed learning orientation of workers. It seems important for HR to stimulate a self-directed learning orientation. This could be done for instance by means of coaching or direct instruction, by creating work situations that explicitly call for a self-directed learning orientation and that rewards workers who show high levels of self-directed learning.

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Chapter 6
The Use of Personal Development Plans (PDPs) in Organizations and the Role of Its Perceived Purpose

Nina Ketels, Simon Beausaert and Mien Segers

Introduction

In today's fast changing knowledge economy, organizations are forced to give priority to strategic human resource development to gain and maintain a competitive advantage (Guthridge et al. 2008). For this reason, assessment tools, like Personal Development Plans (PDPs), are increasingly implemented to manage employees' lifelong learning. PDPs are used for various purposes in practice, ranging from a more evaluative purpose; accountability, selection, or certification on the one hand; to learning and development on the other hand (Smith and Tillema 2001). In this study, we focus on the influence of the nature of the PDP's perceived purpose on its use and practice, on the employee's performance as well as on the relation between the PDP practice and performance.

Throughout the literature the power of the tool to support the employees' professional development is stressed (Darling-Hammond and Snyder 2000; Smith and Tillema 2003). Therefore, it can be questioned if implementing PDPs also with evaluative purposes (summative assessment) does not jeopardize its developmental power (formative assessment). However, research on the different effects of perceiving different purposes of PDPs, has not been conducted before.

This study is in line with previous research, which indicated that as a consequence of using the tool for both purposes simultaneously, its purpose as well as the guidelines and the structure are not always clear (Dochy and McDowell 1997; Smith and Tillema 2003; Wolf and Dietz 1998). It is argued in assessment literature that one of the quality standards of assessment is making the purpose of the assessment clear

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(e.g., Smith and Tillema 2003), especially in the case of PDPs because of the potential differences in content of and approach to the tool (Arter and Spandel 1991). Furthermore, it is stated that formative and summative assessment have a different audience, i.e., colleagues (developmental; learning and development) and the organization (evaluative; certification and selection), respectively; e.g., it is questioned whether PDPs can be discussed in development interviews as well as in appraisal interviews, conducted by one and the same supervisor (e.g., Beck et al. 2005; Wolf and Dietz 1998). In contrast, it is believed that information gathered during the learning or development process can be very useful for summative evaluation (e.g., Snyder et al. 1998). It becomes clear that the nature of the purpose of the implemented PDP is the reason for numerous differences. In addition, previous research indicated that the nature of the perceived purpose of portfolio assessment influences the assessment and its outcomes (Smith and Tillema 2001). Either nature of the purpose of a PDP, evaluative or developmental, is therefore hypothesized to play a role in the PDP's effectiveness.

Beside the role of the purpose for which a PDP is used, the effects of using a PDP on the employees performance also depends on how the PDP is implemented. Using a PDP does not guarantee that it will result in the employees working on their development. In order to make the PDP effective in guiding and supporting the employee's development, several supporting process conditions are expected to be present, which are derived from research by Chickering and Gamson (1991; Gibbs and Simpson 2004; Smith and Tillema 1998). A distinction needs to be made between supporting process conditions related to the context and supporting process conditions related to individual characteristics of the user of the PDP (Beausaert et al. 2011).

First, we will define what a PDP is and illustrate this with an example from practice. Second, we will elaborate on the various purposes PDPs are used for and, here in line with, on the different types of PDPs. Third, we will focus on the supporting conditions that are necessary to make the use of a PDP effective. Finally, we will introduce the goal of this exploratory study in more detail.

Theoretical Background

What is a PDP?

PDPs originally stem from portfolios that have been used as a showcase by artists, architects, and brokers for a long time (Lyons and Evans 1997). During the past decade, the use of portfolios in educational settings has increased and numerous studies focus on implementing portfolios in education with the purpose of supporting learning and development or achieving certification (Taylor et al. 1999; Austin et al. 2005). Student portfolios consist in most cases of a PDP, a collection of pieces of evidence, and a reflection report (Driessen et al. 2007).

Lately, PDPs as one part of student portfolios have also become increasingly used in organizations. They have been acclaimed as effective tools in supporting employees' continuous learning, improving individual performance, and thus positively influencing organizational performance. In this respect, the validity of portfolio use in organizational settings has received increased attention in literature (Smith and Tillema 2007). This is reflected in the vast amount of theoretical and practice-based literature on this subject (e.g., Wilkinson et al. 2002; Wright et al. 1999), conferences and international workshops or seminars on portfolio assessment and/or PDPs specifically (e.g., The 5th International ePortfolio Conference 2007, 27–29 September). However, empirical research on the purposes and the use of portfolio assessment in organizations is scarce (Austin et al. 2005; Evans et al. 2002; Zeichner and Wray 2001).

Although in the existing literature different terms are used to describe the assessment tool (e.g., logbook, portfolio, or personal professional profile) and although often the same term is used for different applications, the different applications have certain characteristics in common. First, PDPs, the term we will use in this chapter, stem from portfolios, which are widely used in educational settings to support learning and development or to achieve certification (Austin et al. 2005; Taylor et al. 1999). Second, a PDP is an assessment tool that (Brown 1995; McMullan et al. 2003; Redman 1994; Seng and Seng 1996; Smith and Tillema 1998; Snadden et al. 1996):

- Gives a structured overview of the competencies the employee worked on in the past (retrospective) and which competencies the employee is planning to work on in the future and how (prospective);
- Should be composed by the employee himself, mostly in consultation with the supervisor;
- Can function as a basis/structure for performance interviews with the supervisor that provides the employee with feedback and stimulates the employee's reflection; and
- Serves as a decision-making tool, from planning an individual training program to assessing the suitability of a promotion. In other words, since the tool is used for taking various decisions, the tool is used for different purposes.

An Example from Practice

A governmental organization in the Netherlands, also involved in this study, has been using PDPs as part of their annual performance appraisal cycle for 1 year now. Here, the employee's PDP serves as a basis for interviews with their manager, two times a year. In the beginning of the year employees are evaluated regarding their work-related competencies, e.g., communication and team-working skills. Based on this assessment, measurable goals are formulated. Mostly the goals concern the development of competencies which include the undertaking of learning activities (e.g., training or reading recent technical literature). During the year the PDP is

also discussed in more informal conversations with the manager as well as with colleagues and the HR department. At the end of the year a performance appraisal takes places. Here the employee's work-related performance is rated on a scale by discussing questions such as "To what extend did the employee achieve the goals?" and the employee's competence development is assessed by discussing questions such as "What is the employee's level of competencies regarding their function?." As a result, new goals are formulated and decisions are made. The decisions can comprise, e.g., a salary increase or job promotion.

Within this organization, PDPs are used as a strategic tool for various purposes. On the one hand, the PDP is used as an evaluative basis regarding the employee's performance for taking decisions (summative assessment); on the other hand the PDP is used to stimulate and manage the continuous development of human capital (formative assessment). However, not all employees are positive about using a PDP. While some employees perceive it as a helpful tool to structure one's learning, others perceive it as a time thief on which relevant career decisions depend.

Striving for Various Purposes

Commonly a distinction between two purposes has been made: certification/selection on the one hand and learning/development on the other hand, placed on a continuum (Smith and Tillema 2001). Similar to student evaluation or assessment, assessment within organizational settings has mostly been used for purposes of accountability and promotional decisions, finding out if and to what extent formerly defined objectives have been met. This purpose is referred to as assessment *of* learning or summative assessment. In the past decade, however, a vast amount of studies have evidenced that assessment is a powerful tool to support learning and development as well, referred to as assessment *for* learning or formative assessment (Assessment Reform Group 1999; Dochy and McDowell 1997; Gibbs 1999; Perrenoud 1998).

Next, based on a literature review on the purposes, Beausaert et al. (2011) formulated effects and supporting conditions of PDPs, nine clusters of purposes for which a PDP can be used: (1) Professional or personal development; (2) reflective learning; (3) providing evidence; (4) documenting; (5) certification, selection, and promotion; (6) external mobility; (7) coaching; (8) stimulating confidence; and (9) organizing. The purposes professional development, reflective learning, coaching, stimulating confidence, and organizing can be categorized as developmental purposes, while the purposes providing evidence, certification, selection and promotion, documenting, and external mobility, can be seen as evaluative purposes.

According to the different purposes a PDP is used for, different types of PDPs are distinguished. Tillema (2001) discusses the dossier-type portfolio, the course-related learning portfolio, and the reflective learning portfolio. First, the dossier-type portfolio serves a certification/selection purpose. Similarly, the terms "show" portfolio (Bunker and Leggett 2004) as well as "product" or "showcase" portfolio (Moore and Bond 2002) are used in the literature. Second, the course-related learning

portfolio serves a developmental purpose. It is used in order to enable assessment as well as further development during a learning program (Winsor et al. 1999). Third, the reflective learning portfolio is used in order to document and illustrate the process of learning and growth (Smith and Tillema 1998). Other terms used in the literature to refer to this type of portfolio, are: the "working" portfolio (Bunker and Leggett 2004) or "process" portfolio (Moore and Bond 2002).

Supporting Conditions

When a PDP is used for developmental purposes, it is an instrument that structures the undertaking of learning activities and guides the reflective conversations with the supervisor. However, based on the research of Chickering and Gamson (1991) in order to make this happen, several supporting process conditions are expected to be present (see also Gibbs and Simpson 2004; Smith and Tillema 1998). We make a distinction between supporting process conditions related to individual characteristics of the user of the PDP and supporting process conditions related to the context (Beausaert et al. 2011).

Supporting Conditions Related to the Employee

The characteristics of the individual learner play an important role regarding the use of the PDP for supporting learning and development of the employee. In that sense, Austin et al. (2005, p. 181) speak of a PDP, respectively, a portfolio as an instrument that requires "an idealized type of individual who knows how to self-reflect, is open to change, interested in his own development and knows how to organize himself and his environment to support learning." In accordance with Gibbs and Simpson (2004), the following supporting conditions related to the individual's characteristics will be taken into consideration: the quantity and quality of distributed effort as well as the reaction of the learner to received feedback as well as the individual's perception regarding value of the construction of the PDP for learning. Gibbs and Simpson (2004) define these conditions as vital for any mode of assessment to influence learning and performance.

Quantity of Learner Effort Sufficient effort of the learner comprises that sufficient time is captured and that the effort is distributed evenly across topic and time. Furthermore, the learner needs to feel that they have to do so in order to do well in the assessment (Gibbs et al. 2003). Sufficient effort supports productive learning activities, which involve learners in deep learning. There is empirical evidence for a direct relationship between the quantity of learner effort and learning and developing (Berliner 1984; Gibbs and Simpson 2004; Gibbs et al. 2003).

Quality of Learner Effort High quality of learner effort demands engagement in productive learning activities as well as the communication of clear and challenging

purposes that are understandable for the learner (Gibbs et al. 2003). A clear formulation of purposes has an influence on the quality of learner effort since learners who understand their purpose can orient their behavior toward these aims (Bunker and Leggett 2004). Other advantages of formulating the tool's purposes in advance are: smooth processing, enlarged engagement, and less confusion. Besides, according to studies done by Chickering and Gamson (1991) high expectations focusing on learning positively reinforce learning. Furthermore, there is empirical evidence for a direct relationship between the quality of learner effort to learn and the learner's development in educational settings (Berliner 1984; Gibbs and Simpson 2004; Gibbs et al. 2003).

Reaction to the Received Feedback Previous research on self-directed learning of adults found receiving valid feedback and informative support to be essential ingredients for effective learning (Peterson 1995). Nevertheless, receiving feedback is not sufficient. PDPs only contribute to development if the learner is willing to accept this feedback (Tillema 1998). The literature coins the term "feedback orientation," which describes the overall receptivity to feedback and the extent to which individuals welcome guidance and coaching (London and Smither 2002). In particular, liking and valuing feedback, seeking it, being able to process other's view of oneself mindfully, and feeling accountable to react to feedback characterizes a positive feedback orientation (London and Smither 2002). It comprises that the learner receives and attends to feedback as well as that actions are executed that improve learning. This "feedback effect" is essential for effective PDP assessment (Gibbs and Simpson 2004; Gibbs et al. 2003).

Perceived Value of PDP Construction By using a PDP employees can make an active contribution to their own knowledge construction, which is beneficial to learning outcomes (Sluijsmans 2002). Gibbs et al. (2003) state that the assessment itself, the construction of the PDP influences the effectiveness. Using and thinking about the PDP engage the learner in productive learning activity and thus have a positive influence on the quality of learning. Furthermore, the construction itself is seen as a deep learning experience in contrast to surface learning experience (memorization; Gibbs et al. 2003). Accordingly, employees should perceive the act of constructing the PDP and discussing the tool as deep learning experiences.

Supporting Conditions Related to the Assessment Context

Supporting conditions related to the assessment context include the quantity and quality of the feedback, delivered on the PDP.

Quantity of Feedback Feedback needs to be given frequently as well as quickly enough in a sufficiently detailed form. If feedback is given irregularly, too late, or in a very broad way, the learner cannot use it properly. Therefore, it is necessary that feedback is delivered or received immediately, that meetings about the PDP happen regularly and go into depth (Chickering and Gamson 1991). Also Wade and

Yarbrough (1996) found that the quantity of feedback information may influence the acceptance and use of feedback for further learning.

Quality of Feedback Gibbs et al. (2003) have mentioned "feedback quality" as a necessary condition for effective assessment. Accordingly, high feedback quality implies a focus on learning. Furthermore, it needs to be understandable for each individual learner as well as linked to the purpose of PDP assessment. This includes, e.g., that the feedback is realistic as well as specific. Research by Black and William (1998) proves a relation between feedback quality and effective learning.

Research Question

This study poses three research questions: (1) does the employee's perception of the nature of the PDP purpose predict the perceived performance, (2) does the employee's perception of the nature of the PDP purpose predict the perceived PDP practice, and (3) does the employee's perception of the PDP practice mediate the relation between the perceived purpose and the employee's performance? We focus on the perception of the employees that work with a PDP since research has shown that not the actual situation but the individual's perception influences the learning approach and outcome (Ramsden 2003; Prosser and Trigwell 1999; Biggs 2003). PDP practice is measured by the perceived supporting conditions for effective PDP use. The conditions are selected based on the research of Chickering and Gamson (1991; Gibbs and Simpson 2004). Next, performance is measured by asking to what extent employees perceive that their performance has improved due to working with a PDP.

Based on the aforementioned literature, it is hypothesized that a perceived developmental purpose will predict the employee's performance significantly as positive. In contrast, the perception of an evaluative purpose regarding the PDP is expected to influence performance significantly as negative. Next, it is hypothesized that the PDP purpose influences the employee's perception of the discerned PDP practice. Finally, it is expected that the PDP practice mediates the relation between the perceived purpose of the PDP and the employee's performance.

Methodology

Participants and Procedure

Questionnaires were taken from 64 employees who are working with a PDP and, are employed in two different organizations in the Netherlands. Seventeen questionnaires were collected from teachers, office workers, and managers at a Dutch institution for higher education. The employees were working with a PDP on a voluntary basis

for approximately 1 year when the questionnaire was taken. The development plan serves as a basis for performance interviews with the manager, two times a year. During the performance interviews the employee's performance is assessed, future objectives are determined and his or her development is monitored (organization 1). Next, 47 questionnaires were gathered from a Dutch municipal organization, as described earlier in the practical example (organization 2). Since both organizations apply similar assessment cycles, we combined both datasets.

Of the 64 participants, 25 were men and 39 were women. Fifteen had a university diploma, 31 had a college diploma, 14 had a vocational high school diploma, and 4 had a secondary education diploma. The employees were between the age of 41 and 45 years, on an avarage. The average number of years of experience was between 6 and 15 years. Five have been working with portfolio assessment for 0–5 months, 3 for more than 3 months, 10 for more than 6 months, and 27 for more than 1 year, and 19 for more than 2 years. The portfolio is discussed with the team leader (44), oneself (22), the department manager (16), colleagues (6), HR department (2), the director (1), or other (5). The participants have one (12), two (22), three (18), four (2), or more (5) meetings per year to discuss the portfolio. They spend time working on their portfolio weekly (2), monthly (8), every half-year (37), once a year (9), or less than once a year (8). A digital version of the questionnaire was sent to the first organization and research assistants who visited and distributed the questionnaires during working hours in the second organization.

Instruments

The distributed questionnaire uses different Likert scales to measure the different constructs. The scales were originally in English and were translated into Dutch, since both participating organizations are from the Netherlands. The guidelines of the International Test Commission were followed (Hambleton 1994). The following constructs were researched: the nature of the perceived purpose, the perceived PDP practice, and the perceived employee's performance.

The Perceived Goal Questionnaire To measure the purposes an organization aspires by implementing PDPs according to the employee, the "Perceived Goal Questionnaire" (PGQ) was used (Beausaert et al. 2011). It rates various purposes on a 5-point-Likert scale concerning the strength of its pursuit going from "never" to "always." The 13 items were divided into two categories of purposes, which are based on the distinction made by Smith and Tillema (2001). The first category comprises purposes that are related to certification and selection, e.g., "preparing job interviews" or "accreditation/reaching standards." The second category includes learning and development purposes, e.g., "stimulating (self) reflection" or "provide evidence for development."

To assess the validity of the two distinct categories of evaluative and developmental purposes, we performed a principal components analysis (PCA) on the items of the

Table 6.1 Principal component analysis for the perceived purpose questionnaire

Perceived purpose	Component 1	Component 2
Planning of future learning activities	0.90	–
Motivate	0.86	–
Learning/stimulate reflection	0.82	–
Personal/professional development	0.75	–
Mean to receive coaching	0.71	–
(Self-) assessment	0.57	–
Selection/promotion	0.46	0.44
Stimulate organizational development	0.45	–
Mean to collaborate with colleagues	0.42	–
External selection interview	–	0.77
Certificate/license	–	0.77
Accredit/achieve standards	–	0.63
Delivering evidence	–	0.62

two scales. The screeplot indicated the existence of two factors. The subsequent PCA with oblimin rotation resulted in two factors with item loads of 0.40 and more. The first component had an eigenvalue of 5.74 (corresponding to 44% of the explained variance) and the second component had an eigenvalue of 1.40 (explaining 11% of the explained variance). All items that are categorized as learning purposes according to Smith and Tillema's theory (2001) loaded on the first factor, developmental purposes, while almost all items which belonged to the evaluative purposes component, loaded on the second factor, the evaluative purposes (Table 6.1). One item ("selection/getting internal promotion") showed a significant cross-load and was deleted. Cronbach's alpha was 0.87 for the evaluative purposes scale and 0.68 for the developmental purposes scale. In summary, the PCA resulted in a questionnaire consisting of two scales. The first scale, namely the evaluative purpose scale, consisted of eight items while the second scale, the developmental purpose scale, comprised four items.

Assessment Experience Questionnaire (AEQ) The PDP practice, as perceived by the employee, is measured with an adapted version of the "Assessment Experience Questionnaire" (AEQ) (Segers et al. 2008). It is based on 11 conditions for assessment to enhance learning (Gibbs et al. 2003; Gibbs and Simpson 2004). Within 36 items that focus on the feedback conditions the following six components are measured on a 5-point-Likert scale ranging from "totally disagree" to "totally agree": (1) The quantity of employee effort (e.g., "With the PDP it is possible to do quite well without studying too much"), (2) the quality of employee effort (learning; e.g., "Making the PDP brought things together for me"), (3) the quantity of feedback (e.g., "The feedback comes back very quickly"), (4) the quality of feedback (e.g., "The feedback helps me to do things better"), (5) the effect of the feedback (e.g., "I tend to only read the marks"), and (6) the perceived value of the construction of the PDP ("While working on my PDP I learned new things"). The questions of the AEQ were adapted from an educational to an organizational setting. Thus, e.g., "I have to work on my PDP on a regularly basis to get good grades for this course" became "I have to work on my PDP on a regularly basis to get good evaluations." A reliability analysis

Table 6.2 Variables, instruments, number of items and Cronbach's alphas for the different variables in this study

Construct	Variable		Instrument	Items	Alpha
Perception of the PDP	Nature of perceived PDP purpose	Evaluative nature	Perceived goals questionnaire	5	0.68
		Developmental nature	(Beausaert et al. 2011)	8	0.87
	Perceived PDP practice	Quantity of effort	Adapted assessment	6	0.70
		Quality of effort	Experience questionnaire (AEQ)	6	0.50
		Quantity of feedback	(Gibbs et al. 2003)	6	0.58
		Quantity of feedback		6	0.70
		Effect of feedback		6	0.70
		Construction of portfolio		6	0.56
Perceived performance			Adapted output of transfer behavior scale (Xiao 1996)	6	0.93

resulted in the deletion of two items of the quality of employee effort scale ("When I am working on my PDP, it is not clear to me what a good PDP is" and "The PDP is not really challenging") and the deletion of one item of the quality of feedback scale ("The feedback usually indicates how good I am doing in comparison with colleagues"). Finally three items of the construction of the PDP scale were deleted ("To construct the PDP I only lined up some facts," "I think I forget everything I have learned during the PDP-conversation immediately after," and "A PDP can get a good judgment even if you did not work on your competencies"). This resulted in Cronbach's alphas of 0.69, 0.62, 0.58, 0.81, 0.70, and 0.89, which shows that the items of the quantity of employee effort scale were differently interpreted by the employees than by students. In contrast to students, employees perceived the fact of spending not too much time on their PDP as a proof of good time-management.

Performance The perceived improvement of performance is measured by using an adapted version of the "Output of Transfer Behavior Scale" (Xiao 1996). It contains six items, scored on a 5-point-Likert scale ranging from "totally disagree" to "totally agree." The adapted version does not measure the transfer of newly adapted knowledge skills and attitudes, but measures the effect of using a PDP on the performance, e.g., Xiao's "Using the new KSA has helped me improve my work" was translated into "Using a PDP has helped me to improve my work." The Cronbach's alpha was 0.93. To assess the validity of the performance scale, we performed a PCA on the items of the scale. The screeplot clearly indicated the existence of one factor with item loads of 0.76 and more. The one component had an eigenvalue of 4.42 (corresponding to 74% of the explained variance). Cronbach's alpha was 0.93.

We refer to Table 6.2 for a detailed overview of the constructs, variables, instruments, number of items, and alphas of the different scales.

Data Analysis

First, the mean scores and standard deviations were calculated for the different variables involved in this study, namely the two subscales of the PGQ, the six scales measuring the PDP practice, and the employee's perceived performance scale. A Pearson correlation analysis explored the strength of the linear relation between the scales (Table 6.3). Second, in line with the first two research questions two hierarchical regression analyses were executed with gender, age, level of education, experiences, and team membership as control variables. The first hierarchical regression analysis included PDP purpose as independent variable and employee performance as dependent variable in order to identify whether the perception of the nature of the purpose predicts the perceived employee's performance (Table 6.4). Next, a hierarchical regression analysis with PDP purpose as independent and PDP practice as dependent variable determined whether the nature of the perceived purpose determines the perceived PDP practice (Table 6.5).

Finally, in line with the third research question, a mediation analysis was conducted in order to test if the PDP practice partially explains the relation between the perceived purposes and the employee's performance (Table 6.6). To verify the mediation hypothesis that says that the relation between the perceived purpose (independent variable) and performance (dependent variable) is mediated by the PDP practice, regression analyses were executed using a procedure that is based on four steps (Kenny et al. 1998). In step 1, the size of the relation between the independent variable (perceived purpose) and the dependent variable (performance) is examined. Step 2 looks for a significant relation between the independent variable and the mediating variables (PDP practice). Step 3 assesses whether there is a significant relation between the mediating variable and the dependent variable, while controlling for the independent variable. In step 4, the decrease of the relation between the independent and the dependent variable is questioned when we control for the mediating variable. Finally, the Sobel test (Sobel 1982) was conducted to determine if the indirect effect from the independent to the dependent variable through the mediator is significant or not.

Results

Preliminary Results

Table 6.3 shows the descriptive (means and standard deviations) and correlations between the involved variables. The resulting Pearson correlation coefficients indicate that a perceived developmental purpose of the PDP correlates significantly as positive with the entire individual and context related components of the PDP practice as well as with employee performance. Furthermore, the results indicate that a perceived evaluative nature of the PDP's purpose only correlates significant and

Table 6.3 Means, standard deviations and correlations

	Mean	SD	1	2	3	4	5	6	7	8	9
Developmental purpose	3.04	0.74	1	–	–	–	–	–	–	–	–
Evaluative purpose	2.05	0.78	0.57**	1	–	–	–	–	–	–	–
Quantity of employee effort	2.72	0.60	0.49**	0.46**	1	–	–	–	–	–	–
Quality of employee effort	2.85	0.66	0.57**	0.41**	0.74**	1	–	–	–	–	–
Quantity of the feedback	3.24	0.54	0.27*	−0.11	−0.12	0.11	1	–	–	–	–
Quality of the feedback	3.43	0.65	0.43**	−0.07	0.26*	0.50**	0.49**	1	–	–	–
Reaction to the feedback	3.53	0.55	0.37**	−0.04	0.22	0.40**	0.36**	0.60**	1	–	–
Construction of the PDP	2.84	0.69	0.60**	0.33*	0.56**	0.59**	0.13	0.43**	0.35**	1	–
Performance	2.93	0.63	0.53**	0.24	0.44**	0.51**	0.23	0.46**	0.33**	0.68**	1

The coefficients are Pearson's correlation coefficients

*$p < 0.05$; **$p < 0.01$

Table 6.4 Hierarchical regression analysis of the nature of the perceived purpose scales on performance

Performance			
		β	ΔR^2
Step 1	Gender	−0.01	–
	Age	−0.40*	–
	Level of education	−0.21	–
	Experience	0.22	–
	Team membership	−0.14	–
		–	0.16
Step 2	Gender	0.04	–
	Age	−0.20	–
	Level of education	−0.12	–
	Experiences	0.18	–
	Team membership	−0.16	–
	Developmental purpose	0.55**	–
	Evaluative purpose	−0.16	–
		–	0.19**

The reported regression coefficients are standardized coefficients

*$p < 0.05$; **$p < 0.01$

as positive with the quantity and quality of the employee's effort and the construction of the PDP. A perceived evaluative purpose does not significantly correlate with performance. Next, the Pearson correlation coefficients indicate that except for the perceived quantity of the received feedback, all components of the PDP practice correlate significantly as positive with performance (quality of employee effort, quality of received feedback, the reaction to feedback, and the perceived construction of the PDP). Finally, the correlation between an evaluative and developmental purpose of the PDP is significant and positive.

Regression Analysis

To begin with, the results of the regression analysis providing an answer to the first research question "*Does the employee's perception of the nature of the PDP purpose predict the perceived performance?"* partly confirm our hypothesis. As expected, a PDP that is perceived as a developmental learning tool predicts performance significantly as positive ($\beta = 0.55$; $p < 0.001$). In contrast to our expectations, the relation between perceiving an evaluative purpose and performance is negative, but not significant ($\beta = -0.16$; *ns*; see Table 6.4). In addition, it was found that age influences if an employee's performance improves because of using a PDP. The younger the employee, the more his or her performance improves because of using a PDP.

Next, in order to answer the second research question "*Does the employee's perception of the nature of the PDP purpose predict the perceived PDP practice?*" a

Table 6.5 Hierarchical regression analysis of the nature of the perceived purpose scales on the PDP practice components

		pr. 1		pr. 2		pr. 3		pr. 4		pr. 5		pr. 6	
		β	ΔR^2	β	ΔR^2	β	ΔR^2	β	ΔR^2	β	ΔR^2	β	ΔR^2
Step 1	Gender	−0.10	–	−0.02	–	.05	–	0.00	–	0.07	–	−0.11	–
	Age	−0.18	–	−0.28	–	−.16	–	−0.34*	–	−0.57**	–	−0.12	–
	Level of education	−0.35**	–	−0.25*	–	−.05	–	−0.05	–	0.09	–	−0.36**	–
	Experience	0.07	–	0.04	–	.11	–	0.15	–	0.46**	–	0.09	–
	Team membership	0.04	–	0.25*	–	.10	–	−0.06	–	0.08	–	−0.04	–
		–	0.14	–	0.19	–	0.03	–	0.09	–	0.23**	–	0.13
Step 2	Gender	−0.07	–	0.03	–	0.09	–	0.06	–	0.11	–	−0.05	–
	Age	0.07	–	−0.03	–	−0.08	–	−0.22	–	−0.47**	–	0.10	–
	Level of education	−0.18	–	−0.09	–	−0.06	–	−0.05	–	0.09	–	−0.20	–
	Experiences	0.05	–	0.01	–	0.07	–	0.09	–	0.41**	–	0.04	–
	Team membership	0.05	–	0.26*	–	0.06	–	−0.12	–	0.03	–	−0.05	–
	Developmental purpose	0.34*	–	0.45***	–	0.47**	–	0.65**	–	0.49**	–	0.64**	–
	Evaluative purpose	0.27	–	0.14	–	−0.42*	–	−0.53**	–	−0.38**	–	−0.02	–
		–	0.21**	–	0.22**	–	0.17**	–	0.30**	–	0.17**		0.31**

The reported regression coefficients are standardized coefficients

*$p < 0.05$; **$p < 0.01$

Table 6.6 Mediation analysis of PDP practice components as mediators between perceived developmental purpose and performance

Dependent variable	Mediator	Step 1	Step 2	Step 3	Step 4	Sobel	R^2
Performance	Effort quantity	0.53**	0.49**	0.24*	0.41**	1.83	0.33**
	Effort quality	0.53**	0.57**	0.31*	0.36**	2.21*	0.34**
	Feedback quantity	0.53**	0.27*	0.09	0.51**	–	0.29**
	Feedback quality	0.53**	0.43**	0.29*	0.41**	2.07*	0.35**
	Reaction to feedback	0.53**	0.37**	0.16	0.47**	–	0.30**
	Construction of the PDP	0.53**	0.60**	0.57**	0.19	–	0.49

Step 1 Pad from the independent variable (developmental nature of the perceived goal scale) to the dependent variable (performance); *Step 2* Pad from the independent variable to the mediating variable (constructing the PDP); *Step 3* Pad from the mediating variable to the dependent variable (controlled for the independent variable); *Step 4* Pad from the independent variable to the dependent variable (controlled for the mediating variable); For the Sobel test, unstandardized beta coefficients are used

*$p < 0.05$; **$p < 0.01$

hierarchical regression analysis was executed which partly confirmed our expectations. Confirming our hypothesis, it was found that a perceived developmental purpose is significantly positive related to all components of the PDP practice: quantity ($\beta = 0.34$; $p < 0.05$) and quality of employee effort ($\beta = 0.45$; $p < 0.01$), quantity ($\beta = 0.47$; $p < 0.01$) and quality of received feedback ($\beta = 0.65$; $p = 0.01$), the employee's reaction to the received feedback ($\beta = 0.49$; $p < 0.01$) as well as the construction of the PDP ($\beta = 0.64$; $p < 0.01$). Furthermore and also in line with our hypothesis, the results indicate that a perceived evaluative purpose is significantly negative related the perceived quantity ($\beta = -0.42$; $p < 0.05$) and quality of received feedback ($\beta = -0.53$; $p < 0.01$), as well as the perceived reaction to the feedback ($\beta = -0.38$; $p < 0.01$). However, in contrast to our expectations the relation between perceiving an evaluative purpose and contribution of employee effort (quantity and quality) ($\beta = 0.27$; *ns* and $\beta = 0.14$; *ns*) and the construction of PDPs were not significant ($\beta = -0.02$; *ns*; see Table 6.5). It should be noted that different variables, which we controlled for, influence the PDP practice. In fact, age, level of education, experience, and team membership influence PDP practice components.

Mediation Analysis

Elaborating further on the latter regression analysis (Table 6.5) and in order to answer the third research question "*Does the employee's perception of the PDP practice mediate the relation between the perceived purpose and the employee's performance?*" mediation analyses were executed for each PDP practice component, mediating the relation between the employee's perception of the developmental purpose of the PDP

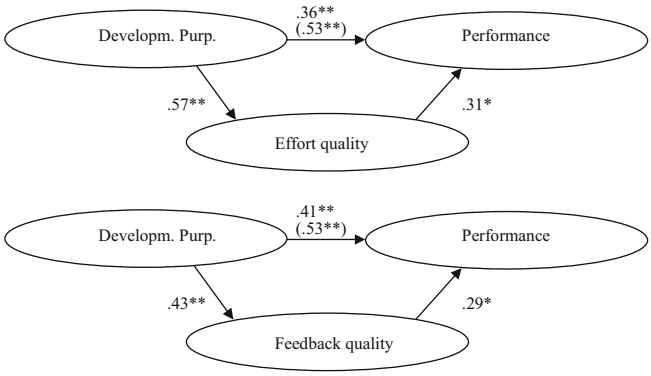

Fig. 6.1 Mediation effect of two PDP practice components between perceived developmental purposes and performance

and his or her performance (Table 6.6 and Fig. 6.1). The mediation analyses indicate that the relation between the developmental purpose and performance is significantly mediated by the quantity and quality of the employee's effort and the quality of the feedback delivered to the employee. The Sobel test (Sobel 1982), however, showed that the relation between perceived developmental purpose and performance through effort quantity was not significant. The other PDP practice components also did not mediate the relation between the perceived developmental purpose and performance (Step 3 or Step 4 was not significant).

Discussion

PDPs are extensively taking a central role within the assessment cycles in organizations and are being used for different purposes. Commonly a difference has been established between developmental purposes on the one hand and evaluative purposes on the other (Smith and Tillema 2001). Nevertheless, as a consequence of using the tool for both purposes, employees' self-protection and fear of underachieving may lead to the collection of unauthentic evidence and the construction of invalid PDPs instead of open reflection on the employee's learning (Smith and Tillema 1998, 2001). Other researchers argued that formative (learning and development purposes; e.g., development interviews) and summative assessment (certification and selection purposes; e.g., appraisal interviews) should not be combined and conducted by the same supervisor (e.g., Wolf and Dietz 1998); while in practice the PDP is often discussed in development interviews as well as in appraisal interviews.

Therefore, the aim of this study was to research the influence of the employee's perception of the purposes a PDP is used for on how the employee uses the tool and on his or her performance. In particular, positive relations between perceived developmental purposes and PDP practice as well as performance improvement were found.

Accordingly, perceiving the purposes stimulating motivation, reflection, coaching, or collaboration influences the PDP practice (employee effort's quantity and quality, the perceived value of constructing a PDP, the perceived quantity and quality of received feedback as well as feedback-related employee reactions), and finally the employee's performance positively. This is in line with research by Smith and Tillema (2001), which prove long-term influences of using a PDP on professional development. Similarly, Wildy and Wallace (1998) conducted a study that researched whether using a portfolio improves the performance and accountancy of school leaders ($N = 73$). For this research, three different methods were combined, namely: portfolio-analysis, surveys, and observations. Evidence was found that administrators, who use a PDP, develop their professional knowledge and connect it with their own practice. Besides, it was found that the school leaders perceive the goal for which portfolio assessment is used very differently, going from using a PDP to meet the standards to using a portfolio to show the acquired competencies. Furthermore, Wilkinson et al. (2002) concluded that using a PDP has a beneficial impact on continuous quality improvement for the profession of doctors in practice.

In contrast, according to the results, perceiving evaluative purposes does not predict performance significantly. Thus, if certification, accreditation, or selection is perceived as purposes of the tool the employee does not perform better because of using a PDP. Furthermore, the results of this study indicated that perceiving an evaluative purpose negatively predicts certain components of PDP practice: the perceived quantity and quality of received feedback as well as feedback related to employee reactions. Thus, while Peterson (1995) has indicated that receiving valid feedback (*and informative support*) stimulates effective learning, a perceived evaluative purpose might encourage behavior that diminishes the perceived feedback and leads toward employees not taking into account the given feedback. However, the employee's effort and perceived value of constructing the PDP are not positively influenced by an evaluative use. Yet, research by Berliner (1984) has stated that in order to positively influence a relationship between learning effort and outcome, a differentiation between various purposes might be necessary. Besides, perceiving the PDP as an evaluation tool does not make the employees think and reflect, it does not make the PDP practice a learning experience. It can be concluded that it jeopardizes its learning and development purpose. Moreover, to perceive higher performance through using a PDP it is most crucial for employees that they perceive the creation of the PDP as a way of clarifying things, helping them to understand things better and making them learn new things. In line with Bunker and Leggett (2004), who stress the importance of a clearly formulated purpose, the supervisor should introduce the employees properly with the purpose and the set-up of the tool.

These results are in line with research conducted within a school setting. Beck et al. (2005) compared the effects of formative and summative portfolios on the professional outcomes of pre-service and beginning teachers. They concluded that portfolios focusing on teacher development better-supported professional outcomes than did the summative accountability portfolio. Similarly, Tillema (2001) found that a strong preoccupation with performance appraisal (summative assessment) might counter learning and development purposes.

In addition, we researched the mediating role of the PDP practice components between the perceived developmental purposes and performance. It was found that effort quality and feedback quality mediates the relation between perceived developmental purposes and performance. This implies that the employee needs to be supported in delivering high-quality effort; meaning that they reflect profoundly. Therefore, the supervisor needs to give the responsibility to the employee to empower self-development and reflection (London and Smither 1999). Furthermore, the employee should be able to reflect. This skill can be acquired and needs to be practiced (Oslan et al. 2007). This also means that supervisors need to be trained in how to guide their employees who are using a PDP and in giving high-quality feedback.

It should be noted that this research also found that perceiving evaluative purposes and perceiving developmental purposes correlate significantly positively. This may be explained by the fact that formative and summative purposes are often combined, e.g., in the organization involved in this study, the PDP is discussed in the appraisal interview as well as in the development interview with the manager.

Limitations

This study implies several limitations, which could be faced by future research. First, it is not clear to which degree the results of the study can be generalized. After all, the data are based on the perception of the employees and we might expect some socially desirable answers by which the results could be distorted. For future research it might therefore be of interest to question the perception of several informants, such as supervisors, peers, and team leaders.

Second, this research was conducted in two organizations with a rather small sample size and a low response rate in one of the participating organizations. Since this is an exploratory study, the amount of participants is not a problem, but the extent to which the results can be generalized to other organizations is questionable. It is also possible that the employees who did not participate in the study caused selective dropout, e.g., it is possible that the employees who would score low on performance did not fill in the questionnaire. Next, this research focused on one educational organization and one municipality in the Netherlands. The extent to which the results can be generalized to other organizational or national settings and levels is not studied. Consequently, further research in different organizational settings, e.g., in different professional sectors or differently sized organizations, might produce different research results. In addition, the differences between individuals (age, educational level, and experience) who are using assessment tools with different effects should be researched further.

Third, since this study has a cross-sectional design changes over time cannot be determined. Therefore, we cannot draw conclusions about the direction of the effects. We found relations, but it is not possible to draw conclusions regarding their

causality. Longitudinal research is required, which might shed light into the causality and direction of the effects that were found in this research.

A fourth limitation concerns the low internal reliabilities for some of the scales which were used in this research. Two components of PDP practice; the values for the quality of employee effort and feedback quantity have a Cronbach's alpha of 0.62 and 0.58. Next, the Cronbach's alpha was 0.68 for the developmental purposes scale. The low reliabilities may be explained by the fact that the scales have been translated from English to Dutch and were used in an educational setting first and were now transformed in order to make them applicable to an organizational setting. Future research should focus on the validation of the translated scales, used within an organizational setting.

Practical Implications

This study has few implications for human resource development in organizations. First, the study supports previous research findings that employees perform better because of the PDP if the tool is introduced and used as a learning and development tool and not as an instrument for certification or selection. In other words, PDPs should especially be used to support the employee's learning and development and should not be linked to appraisal at the same time. However, because of practicalities the tool is often used for both purposes. The question, which arises then, is: How to find a balance between formative and summative assessment? The following suggestions could be taken into account: (1) Keep learning and development interviews separate from performance interviews. The performance interviews can still be based on a selection of evidence which is collected in the PDP and which is used for learning and development interviews. (2) Similarly, have the two different kinds of interviews conducted by a different person in order to split up both purposes completely. A coach should conduct the interviews with learning and development purposes, while the interviews with certification and selection purposes should be executed by the supervisor. In practice, however, the PDP interviews and the appraisal interviews are mostly conducted by one and the same supervisor. (3) Make a distinction between the criteria used for discussing the PDP during the learning and development interviews and the criteria used during performance interviews. While growth indicators, making the growth in competencies visible, should be used in the first type of interviews, attainment indicators, pointing out if the specific level of proficiency that was agreed upon before is reached, should be used in the performance interviews.

Second, especially the employee's effort quality and the supervisor's feedback quality mediates the relation between perceiving the PDP as a learning and development tool and performance. This implicates that supervisors should help their employees in delivering high-quality effort by helping and supporting them to reflect profoundly. Therefore, it is important that the supervisor guides and helps the employee during the PDP process by delivering high-quality instructions and feedback

and by being supportive. Supervisors should be trained in guiding and supporting the employees in using a PDP.

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Chapter 7
Determinants, Benefits and Barriers of Informal Learning in The Netherlands

Marjolein C.J. Caniëls and Paul Kirschner

Introduction

Lifelong learning (LLL) has long been taken for granted as being essential for all people and thus as something that will "happen", the idea being that people themselves would make the effort to continue to learn. Where attention was paid to LLL, it was usually through continuing education programmes at universities or private organisations specialised in developing and delivering courses. Noteworthy is that most initiatives saw LLL as formal learning (e.g. an extension of initial formal education). Only recently has LLL become a focal point of Dutch and European policy in relation to innovation, economic growth and social-cohesion, often in conjunction with the perceived need to transform production workers into knowledge workers (CEDEFOP 2009). With this focus, there has also been a broadening of the scope from formal lifelong education to informal LLL. Emphasising the importance of making informal learning visible and valuable is increasingly seen by government bodies as a way to expand LLL. Informal learning takes place outside formal education and training institutions. It encompasses all learning activities that are not formally organised, including learning at work, in leisure time and at home. Informal learning at the workplace includes, for example, on-the-job learning, working alongside more experienced colleagues (i.e. apprenticeship; Bines 1992), working as part of a team and learning from customers, clients and suppliers (Cheetham and Chivers 2000, 2001).

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However, before decisions can be made and policy guidelines can be specified on how to use and value informal learning, we must know how much informal learning is actually being undertaken by individuals and what possible barriers exist to participation. In several countries this challenge has been taken up, with as a notable example the study by Cheetham and Chivers (2000, 2001) in the UK, where 80 practitioners from 20 professions were interviewed, and a questionnaire survey was distributed among 372 practitioners from six professions. They found that on the job learning was rated by respondents as the most important type of informal learning, followed by learning alongside more experienced others and working as part of a team. The types of job environment that were found to be most conducive to professional development were environments in which people were allowed the freedom to find their own ways of doing things and develop their own professional style, while help was made available if and when needed. Respondents reported the need for a balance between on the one hand being offered support when needed and on the other hand being allowed to do things on their own and make mistakes. Cheetham and Chivers (2000, 2001) concentrated on informal learning of professionals in their working environments (i.e. on-the-job) and not whether and how individuals learn outside of the working environment as well.

A study that did incorporate informal learning outside the job is the Work and Lifelong Learning (WALL) survey that was carried out in Canada by the Centre for the Study of Education and Work at Ontario Institute for Studies in Education at the University of Toronto (OISE/UT) in collaboration with the Research Network on New Approaches to Lifelong Learning (NALL). The WALL survey was conducted in 1998 and 2004 among a large representative national sample of 9,063 adult (18 +) Canadians (Livingstone 1999; Livingstone and Stowe 2007). A notable finding was that those who are not taking adult education courses are still very likely to participate continually in job-related informal learning. Furthermore, most respondents saw course-based education and informal learning as complementary. Moreover, older workers (i.e. older than 55) stopped taking part in course-based learning almost completely, while their informal job-related learning only marginally declined.

In the study described in this contribution, we choose the Netherlands as focus because it is a country where informal learning is a widely accepted mode of learning. For example, while most universities and polytechnics require a high school diploma for admission (the Open University of the Netherlands is an exception), it is possible for institutions of higher education to acknowledge informal learning in the admission of first year students (Hagens et al. 2007, p. 8). In 1994, the Ministry of Education, Culture and Science published a study titled “Recognising informal skills”. In the report, a series of measures and activities were proposed that were aimed at boosting the employability of the labour force, which included measures specifically aimed at enhancing informal learning.

While there are data in the Netherlands on participation in formal LLL (i.e. adult education courses), there has been little reliable research on the fuller extent of Dutch engagement in LLL (i.e. informal learning), and on whether this learning is being used to its fullest potential in paid jobs and beyond. The aim of this research is to probe the Dutch population’s perception of key dimensions of paid and unpaid work and of their learning practices. We address the following three basic research questions:

1. What is the relationship between time spent on informal learning by employees and (a) age, (b) level of education, (c) number of working hours per week?
2. What is the relationship between time spent on informal learning by employees and outcome measures, including subjective career success and occupational expertise?
3. What barriers do Dutch adults perceive that keep them from engaging in informal learning?

This contribution presents data from an on-line survey which yielded 520 qualified responses from Dutch citizens between 18 and 64 years old. The analysis is based on descriptive statistics and non-parametric tests.

In this chapter we first present a review of the literature on LLL concepts and research. In the second section, we formulate several hypotheses about factors related to informal LLL and show the current state of affairs of LLL in the Netherlands along these lines. In the subsequent section, we elaborate on our research design and the methodology used. This is followed by the results. Finally we present a conclusion and a discussion of our findings.

Literature Review

LLL is "... all purposeful learning activity, undertaken on an ongoing basis with the aim of improving knowledge, skills and competence" (Commission of the European Communities 2000, p. 3). This concept is not new. LLL became a worldwide topic of discussion in the 1970s with the publication of a report by UNESCO which called for lifelong education as part of cultural and personal growth (Faure et al. 1972). The Organisation for Economic Cooperation and Development reconceptualised LLL by making it a part of the human capital theory (Field 2001). The European Union gave LLL central prominence as part of the human capital requirements of the knowledge economy and presented it as a key factor for the international competitiveness of European businesses and industry (Commission of the European Communities 2000).

LLL, thus, is increasingly seen as central to the human capital requirements of our ever-developing knowledge economy and a key factor in maintaining the international competitiveness of Dutch and European business and industry. This is due to the fact that much valuable and non-trivial learning takes place outside formal programmes of instruction. Individuals learn and profit from experience in both formal educational settings (e.g. continuing education, in-house training) and informal settings (e.g. on-the-job/workplace learning and/or learning from media, museums). As such, LLL is an effect of external and internal conditions to individuals, and it has effects on an individual's professional and personal life.

Traditionally, LLL is divided into formal learning and informal learning (for an excellent discussion of this see Van Merriënboer et al. 2009). Formal learning—as related to LLL—is traditionally an extension of formal schooling which Livingstone (1999) defines as an "age-graded, hierarchically organized, formally constituted system... [with] credentialing programmes to certify one's knowledge competencies for starting one's adult lives" (p. 50). The Cedefop glossary (Tissot 2000, 2004)

notes that it consists of learning that occurs within an "organized and structured context (formal education, in-company training), and that is designed as learning" (Tissot 2000, p. 22). Formal LLL courses and programmes are most often offered by traditional (or new) educational or training institutions and when extended into the adult years are often called continuing education. As such, they constitute the universe of formal LLL (actually lifelong *education*).

Informal learning—according to the Commission of the European Communities (2000)—is learning that "results from daily life activities related to work, family or leisure. It is not structured (in terms of learning objectives, learning time and/or learning support). Typically, it does not lead to certification. Informal learning. . . is non-intentional (or incidental/random)" (Colardyn and Bjornavold 2004, pp. 71). It can, thus, be regarded as a tacit form of learning through everyday activities. Coombs (1985) defined informal learning as "the spontaneous, unstructured learning that goes on daily in the home and neighbourhood, behind the school and on the play field, in the workplace, marketplace, library and museum, and through the various mass media, informal learning is by far the most prevalent form of adult learning" (p. 92).

In 2004, the Research Network on New Approaches to Lifelong Learning (NALL) carried out a telephone survey with a large representative national sample of the adult (18 +) Canadian population ($N = 9{,}063$) to provide quantitative detail on learning and work activities and their inter-relations. The survey confirmed that most adults' detectable individual and collective learning is comparable to an iceberg; only 10% is visible at the surface, yet it is immense in its mostly submerged informal aspects (Livingstone 1999). The survey assessed participation in four aspects of informal learning: employment related, community volunteer work related, household work related and other general interest related. In each aspect, respondents were asked about informal learning activities on several specific themes. The questions used were developed to replicate the content of the Tough (1971) and Penland (1977) interview schedules, with appropriate revisions for changing circumstances (e.g. computer-based learning). The survey generated several interesting results. Notable was that older workers participated less in both adult education courses and in job-related informal learning. However, those not taking adult education courses remain quite active in job-related informal learning. Furthermore, most respondents felt that participating in formal course-based education and undertaking informal learning activities were complementary to each other.

While there is much research and data on formal LLL in the Netherlands and other countries (e.g. Wößmann and Schütz 2006; Bassanini et al. 2005), there is a dearth of reliable research and data on informal LLL and whether this learning is being used to its fullest potential in paid workplaces and beyond. The literature about LLL distinguishes several factors that might positively or negatively be related to informal LLL (see Bassanini et al. 2005 and Desmedt et al. 2006 for extensive overviews). Factors generally identified are:

- Personal traits: education level, age, family composition;
- Position on the labour market: working, without a job, inactive;
- Function characteristics: nature of the function, function level, part time job, temporary work;

- Company characteristics: size, orientation on technological and social innovations, HRM policy;
- Sectoral system: unions, pension rights, funds for on-the-job education;
- Policy aspects: subsidies for education; fiscal arrangements that promote education, social security, minimal duration of formal education, formal education infrastructure;
- Supply of adult education: content, form, place, costs;
- Macro-economic development: economic growth, labour developments; tightness labour market.

While there is little research on the characteristics of those engaged in informal learning, there are a few noteworthy general characteristics of lifelong learners. Personal characteristics such as age or educational background have been found to influence engagement in informal learning (Berg and Chyung 2008). However, research on the relationship between age and informal learning is inconsistent. Tikkanen (2002), Livingstone and Stowe (2007) and Kremer (2005) show that less experienced, younger workers engage in more informal learning, while more experienced older workers view it as less embedded in their work. Therefore older workers are less likely to engage in informal learning activities. In contrast, Livingstone (1999) and Berg and Chyung (2008) find that older people engage as much in informal learning as younger people.

With regard to the association between the level of formal education and participation in informal learning activities, results of previous studies are also inconclusive. Livingstone (2007) found that with increasing educational attainment, the likelihood of participation in further education (formal as well as informal) increases. In contrast, Livingstone (2001) as well as Berg and Chyung (2008) found that the amount of time respondents spent on informal learning was about the same for all levels of education.

The relationship between individuals' engagement in informal learning activities and having a paid or unpaid job is not often subject of study. Livingstone (2007) and Livingstone and Stowe (2007) report that the employed labour force is slightly more inclined to undertake informal learning activities than unpaid volunteer or household workers. Hence, the age of individuals, their education level and their position on the labour market are variables of interest in explaining the amount of time spent on informal learning. We posit the following hypotheses:

1. The amount of time spent on informal learning increases as individuals are less mature (i.e. younger).
2. The amount of time spent on informal learning increases as individuals are more educated.
3. The amount of time spent on informal learning increases as individuals have jobs.

The question remains as to how the outcomes of informal learning were used in the learner's paid and/or unpaid work or in other contexts. Livingstone (1999) reported that the majority of studies focused on documenting the process of informal learning and the areas of learning. Very little is known about the actual outcomes

that are perceived as resulting from informal learning activities (Livingstone 1999). Employability related research has shown that aspects of informal learning are related to employability dimensions (Van der Heijden et al. 2009; Van der Klink et al. 2009). In these studies informal learning is operationalised as interaction with one's supervisor, the learning value of the job and networking opportunities. However, the studies are inconclusive about the informal learning aspects that are related to employability dimensions. Studies that use different samples report varied results.

The barriers people experience keeping them from engaging in learning activities were investigated by McCracken (2005). He categorised into two groups the factors that can be perceived as barriers to learning: intrinsic factors and extrinsic factors. Intrinsic factors are attributed to the individual's perception, motivation and emotions while extrinsic factors are associated with a person's external environment in terms of organisational culture, management development culture and physical resource factors. McCracken found the strongest barriers among managers that are "mid- career" (i.e. in their mid-thirties and forties) and who have attained a certain degree of experience in managerial jobs. While the study dealt with both formal and informal learning activities, it did not differentiate between them. In interviews with 22 managers, three distinct groups emerged, namely managers with mainly intrinsic issues, managers with mainly extrinsic issues and managers with both intrinsic and extrinsic issues. An important recommendation was to develop tailored development packages. The added value of our study lies in the fact that it focuses specifically on perceived barriers to informal learning.

Methodology

Data Collection

To determine how the amount of time individuals spend on informal learning varies with the characteristics of the individuals and of their position in the labour supply, we developed an on-line questionnaire which was distributed among an internet panel. This questionnaire was largely based on the telephone survey in the WALL-studies, but adapted to be used as an on-line questionnaire. It was also more focused on informal learning and was extended to question employability indicators (Van der Heijde and Van der Heijden 2006).

The questionnaire was distributed by an independent research agency making use of on-line research panels that are representative of the Dutch population. Respondents received a small reward for participation, by means of participation points that can be exchanged for gift certificates. The agency made it possible to choose a sample based on geographic and/or demographic characteristics. The target respondents were Dutch citizens between 18 and 65 years old. A decision was made to include no more than 10% freelancers and 10% unemployed, since individuals in these categories are unable to answer most of the questions in our questionnaire; for instance questions about employability aspects.

To increase validity and reliability of the survey instrument, the questionnaire was reviewed by two academic experts on informal learning and one practitioner in human resource management, resulting in several adaptations of the exact wording and layout of items and response options. The data were collected during autumn 2009. The final questionnaire was administered via e-mail with a link to the on-line survey to 800 Dutch citizens. Three e-mail invitations were returned as undeliverable. A total of 797 invitations were assumed to have reached the intended recipients. A total of 600 questionnaires were returned, of which 51 were incomplete. For each respondent the amount of time spent on answering the questions was noted, leading to elimination of 29 questionnaires, because the respondents had filled it in too quickly to be taken seriously. A total of 520 usable responses remained for analysis, resulting in an effective response rate 65.2%, which was seen as very satisfactory for a survey of this length and kind (Kumar et al. 1995; Malhotra and Grover 1998). Complete anonymity was assured to reduce social desirability bias and to increase response rate.

An advantage of such an on-line questionnaire is that there are very little missing data. As foreseen, the most missing data were related to time spent on informal learning per week (12.1%). This leaves us with 457 usable observations for all other questions.

Sample Descriptives

Descriptive data on demographic characteristics of our sample are presented in Table 7.1. Of the respondents, 59.5% were male and 40.5% female. Compared to the Dutch average of 54.3% male and 45.7% female in 2008 (data collected by the Central Bureau of Statistics) our sample has slightly more males and fewer females. At the time of the survey, 13.8% of the respondents held a doctoral or master degree as highest degree earned, 25.2% a (professional) bachelor degree, 11.2% a high school degree (senior level), 41.1% a secondary vocational degree (in Dutch "MBO" or "MAVO/MULO") and 8.8% a lower degree or no degree at all. Our sample is quite representative for the total Dutch labour force for which, respectively, the percentages are 11.6, 21.1, 8.1, 34.8 and 23.6. The average age of the respondents was 40 (Dutch average in the labour force is 39.9 years). Most respondents had average yearly wages of between 30,000 and 40,000 € in 2008. For the total Dutch labour force the average yearly wage is 33,400 € per year (data collected by the Central Bureau of Statistics).

Measures

The questionnaire contained demographic questions on age, sex, current job position, work experience and educational level. The dependent variable, time spent on informal learning, was measured with one item. After a brief explanation about the

Table 7.1 Sample descriptives

Continuous scale	*N*	Min	Max	*M*	*SD*
Age	457	18	64	40	11.65
No. of jobs in past 5 years	450	1	5	2	1
Family members	457	1	7	3	1
Ordinal scale		No of Categories	Min	Max	Mode
Education level (highest diploma)	457	15	None	PhD	Secondary
Yearly wages (euros)	334	12	0	90,000–100,000	30,000–40,000
Dichotomous scale %		Yes	No		
Male	457	59.5	40.5		
Employed	457	100	0		
Job dynamics in past 5 years					
First job acquired	457	12.9	87.1		
Promotion	457	19.0	81.0		
Changed jobs	457	40.5	59.5		
Became unemployed	457	7.4	92.6		
Full-time to part time employed/vice versa	457	10.9	89.1		
Maternity leave	457	7.9	92.1		
None of the above changes	457	37.4	62.6		

definition of informal learning and a few examples, respondents were asked to indicate the amount of hours per week that they spent on informal learning activities. Respondents were also asked to report the outcomes they perceive to be generated by the informal learning they undertook. Indicators of employability, such as subjective career-success and occupational expertise were used for this. Subjective career-success was measured with the measurement scales of Gattiker and Larwood (1986) on a 5-point Likert scale anchored by (1) "Strongly agree" to (5) "Strongly disagree". Sample items of the six items are: "I am drawing a high income compared to my peers", and "I am respected by my peers". Cronbach's alpha measure of internal consistency for these items is 0.729. Occupational expertise (i.e. expertise needed to adequately perform the various job-related tasks and responsibilities) was measured as a construct variable, using 15 items from Van der Heijden et al. (2009) and Van der Heijde and Van der Heijden (2006). Occupational expertise was measured by 15 items on a 6-point Likert scale anchored by (1) "Does not apply at all" to (6) "Applies a great deal". The sample items are: "I consider myself competent to indicate when my knowledge is insufficient to perform a task or solve a problem", and "During the past year, I was in general competent to perform my work accurately and with few mistakes". Cronbach's alpha measure of internal consistency for these 15 items is 0.924. The psychometric characteristics of the scales for subjective career success and occupational expertise were thoroughly investigated by Van der Heijde and Van der Heijden (2006). They indicated that both scales are valid and reliable.

Table 7.2 Means, standard deviations, and correlations

	Mean	*SD*	1	2	3	4	5
Informal learning	5.26	8.43					
Occupational expertise	4.61	0.55	− 0.03				
Subjective career success	3.36	0.52	− 0.02	0.23**			
Hours per week in paid job	33.93	8.99	0.01	0.10*	0.03		
Age	40.60	10.72	− 0.12*	0.04	− 0.05	− 0.07	
Years of formal education	11.54	2.85	0.09	0.07	0.16**	0.07	− 0.27**

N = 457
*$p < 0.05$; **$p < 0.01$

In addition, barriers to informal learning were investigated in the survey using McCracken's (2005) classification. Intrinsic as well as extrinsic factors were studied. Following McCracken (2005) we define intrinsic factors as barriers to learning that are attributed to the individual's perception, motivation and emotions. Extrinsic factors are associated with a person's external environment, categorised as organisational culture, management development culture and physical resource factors. Respondents could tick boxes for all factors that they perceived to have hampered their informal learning.

Data Analysis

The first research question concerns the state of affairs of informal learning in the Netherlands; specifically, the relationship between the time spent on informal learning and background characteristics, including age, education level and number of working hours per week. This research question was developed into three hypotheses. We use descriptive statistics as well as a bivariate correlation between the individual's age and the time spent on informal learning to elaborate on hypothesis 1. Descriptive analysis as well as a non-parametric test is used to see whether the amount of time spent on informal learning is higher as individuals are better educated (hypothesis 2). Hypothesis 3 is addressed by calculating the bivariate correlation between hours worked per week and the amount of time spent on informal learning. We used descriptive statistics to report on how the outcomes of informal learning have been used in the learner's paid and/or unpaid work or in other contexts (research question 2). Descriptive statistics were also used to show the barriers that Dutch adults perceive as keeping them from engaging in informal learning (research question 3).

Findings

Table 7.2 reports the means, standard deviations and correlations between the most important variables. With respect to the dependent variable, people averaged

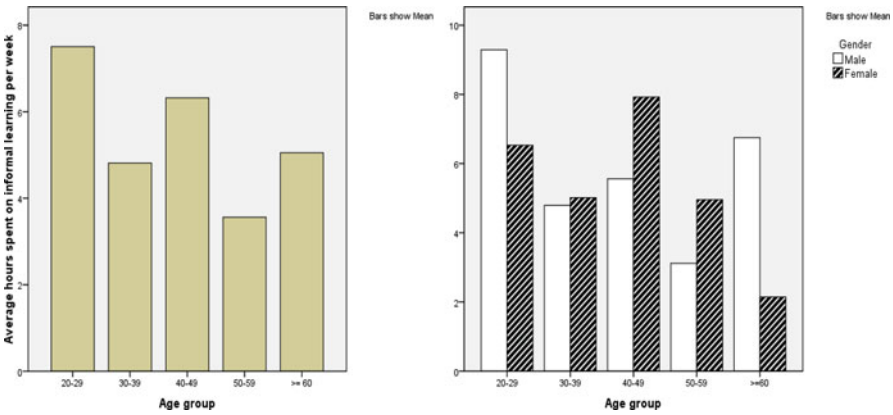

Fig. 7.1 Time spent on informal learning per age group

5.26 hours per week spent on informal learning. Note the negative correlation between age and hours spent on informal learning. The number of years of formal education is positively related to subjective career success and negatively related to age. We will revisit these results when discussing the hypotheses.

Research Question 1: Relation Between Time Spent on Informal Learning and Background Characteristics

Hypothesis 1 Hypothesis 1 posed that the amount of time spent on informal learning increases as individuals are less mature (i.e. younger). Our sample indicates that in the age groups 30–39 and 50–59 the fewest number of hours is spent on informal learning. Looking at sex differences, we see that the average amount of time spent per week on informal learning activities is high for males at the beginning of their professional career (i.e. between 20 and 29 years of age) as well as males in the final stage of their professional career (i.e. older than 60 years of age; see Fig. 7.1). Females are most engaged in informal learning when they are between 40 and 49 years.

When a bivariate correlation was calculated between age and informal learning, a significant negative correlation was found (Pearson's $r = -0.117$, $p = 0.006$), indicating that younger people spend more time on informal learning than older people.

Hypothesis 2 Hypothesis 2 posed that the amount of time spent on informal learning increases as individuals are more educated. Table 7.3 shows the average number of hours per week spent on informal learning by education level. Individuals with a middle-level secondary education are most engaged in informal learning activities (52%). A second large group are those with a university bachelor degree (25%).

Table 7.3 Average number of hours spent on informal learning ordered by education level

	Informal learning (in hours)										
	0		1–10		11–20		> 20		Total within table		% informal learning by education level
Education level	*N*	Percentage	*N*	Percentage	*N*	Percentage	*N*	Percentage	*N*	Percentage	
Lower-level secondary ed.	15	3	22	5	1	0	2	0	40	9	63
Secondary education (middle level) and high school degree	49	11	169	37	13	2	8	2	239	52	79
Bachelor degree	10	2	94	21	6	1	5	1	115	25	91
Master degree	3	1	50	11	10	2	0	0	63	14	95
Total	77	17	335	73	30	7	15	3	457	100	

Table 7.4 Informal learning versus average paid hours worked per week, continuously employed Dutch Labour Force

Hours/week	Informal learning									
	0		1–10		11–20		>21		Total	
1–19	7	2%	23	5%	2	0%	0	0%	32	7%
20–29	17	4%	54	12%	4	1%	3	1%	78	17%
30–39	21	5%	121	26%	11	2%	8	2%	161	35%
40	23	5%	112	25%	10	2%	2	0%	147	32%
41–49	2	0%	14	3%	2	0%	2	0%	20	4%
≥ 50	5	1%	7	2%	0	0%	0	0%	12	3%
Total	77	17%	335	73%	30	7%	15	3%	457	

Looking at the percentage of people with a certain education level engaged in informal learning, 95% of those with a master degree spend time on informal learning activities, while only 63% of those with lower-level secondary education do this. Table 7.3 also shows that 73% of the respondents report spending between 1 and 10 hours per week on informal learning. Only 3% spend more than 21 hours per week. Bivariate correlation between years of formal education and informal learning indicated that the relationship is positive but weakly significant (Pearson's $r = -0.09$, $p = 0.068$).

Our sample violates the normality assumption, hence one-way ANOVA could not be performed. Because of this, we used the non-parametric alternative, Kruskas–Wallis test whose results show that groups of respondents with a different education level indeed differ significantly in their mean number of hours spent on informal learning (Chi-square = 26.475; $p = 0.000$). The lowest mean is found in the group with the lowest level secondary education and the highest mean by respondents with a master degree. This suggests that the level of education is positively related to the amount of time spent on informal learning.

Hypothesis 3 Hypothesis 3 posed that the amount of time spent on informal learning increases as individuals have jobs. Table 7.4 shows the distribution of time spent on informal learning activities. Note that we used identical intervals as those used by Livingstone and Stowe (2007). The largest category is constituted by people working between 30 and 40 hours who are engaged in 1–10 hours of informal learning per week. Bivariate correlation between hours worked per week and informal learning, yielded a nonsignificant and almost non existing relationship (Pearson's $r = -0.005$, $p = 0.454$). Kruskal–Wallis one-way ANOVA revealed nonsignificant differences in means between groups (Chi-square = 6.411; $p = 0.171$). Hence, we find no support for hypothesis 3 in our sample.

Research Question 2: Outcomes of Informal Learning

Descriptives Little research has been conducted on the perceived outcomes of informal learning. Table 7.5 shows what respondents indicated as outcomes generated by

Table 7.5 Outcomes of informal learning ($N = 380$)

Informal learning helps me to ...	%	Informal learning helps me to ...	%
perform my job better	80.3	acquire knowledge about job health and safety aspects	17.6
keep up with new knowledge	72.9	acquire knowledge about labour conditions and rights of employees	15.5
perform new tasks in my job better	56.8	increase my income	13.7
build computer skills	44.7	increase my knowledge of foreign languages	11.8
develop teamwork, problem solving or communicative skills	41.8	get a promotion	11.6
work with new machines	32.4	further develop financial management skills	11.3
further develop planning or management skills	25.8	find a job	6.1
acquire insights into power structures at work	19.5	keep my own business	2.9
keep my job	17.9	Other	7.4

their informal learning. It shows how these outcomes have been used in paid and/or unpaid work or in other contexts. The majority indicates that informal learning helps them to do their job better and keep up with new knowledge in their area of expertise. With respect to the way in which employees use the outcomes of informal learning, 17.7% indicate that informal leaning is needed to keep their job, 13.7% indicate that it helps to increase income and 11.6% that it increases chances for promotion.

Correlation Analysis Career success (Van der Heijde and Van der Heijden 2006) and self-reported occupational expertise (Van der Heijden et al. 2009) can indicate a person's perceived career potential. We expect a positive relation between informal learning and career potential. However, bivariate correlation between informal learning and perceived career success yielded a negative nonsignificant correlation (Pearson's $r = -0.019$, $p = 0.344$), indicating that informal learning is not perceived as being related to career success. This is also the case for informal learning and self-reported occupational expertise (Pearson's $r = -0.028$, $p = 0.273$), indicating that people who spend much time on informal learning activities do not feel that they have much expertise. A possible reason is that may be precisely the people that feel that they have a lot to learn, and are not yet successful in their job, are the ones that engage most in informal learning activities

Research Question 3: Barriers that Keep Dutch Adults from Engaging in Informal Learning

The question remains why individuals choose not to engage in informal learning. What factors hamper informal learning in the perception of Dutch adults? Table 7.6 shows the barriers respondents perceived as keeping them from engaging in informal

Table 7.6 Barriers to informal learning ($N = 134$)

Factor	%	Factor	%
Lack of time	61.2	Activities take place in an unfriendly environment	3.0
Inconvenient time and place of activities	20.9	Fear of failure	2.2
Activities are too expensive	19.4	No need for more education	2.2
Lack of employer support	10.4	Undertaking learning activities is boring	0.7
Family responsibilities	6.0	Lack of availability of child care	0
Health problems	3.7	Other	11.9

learning. The main reasons are: lack of time (61.2%), inconvenient time and place of informal learning activities (20.9%) and cost (19.4%). These three reasons are categorised by McCracken (2005) as extrinsic factors that have to do with physical resource pressures. Apparently, individuals perceive the demands on themselves as very high. This causes time and resource pressures to impact their ability to devote time to informal learning activities. Typical intrinsic factors such as fear of failure and "don't need more education" were only reported by 2.2% of the respondents as hampering informal learning.

Conclusion and Discussion

This study investigated the Dutch population's perception about informal learning activities. The research was based on data from an on-line survey which yielded 520 qualified responses from Dutch citizens between 18 and 64 years old. We addressed key characteristics of the workforce including age, level of education and number of working hours per week and related these to the time spent on informal learning. In addition, we analysed the relationship between time spent on informal learning by employees and outcome measures, including subjective career success and occupational expertise. Finally, we presented data on the perceived barriers that keep people from engaging in informal learning.

The results of this study give an insight into the state of affairs of informal learning in the Dutch labour force. To summarise, the amount of time spent on informal learning increases as individuals are younger and more educated. There is no relationship between having a job and spending time on informal learning. The respondents did not perceive any specific job-related benefits from the time they spent on informal learning activities. Informal learning was not associated with perceived career success or with self-reported occupational expertise. Barriers to participation in informal learning activities stemmed mainly from extrinsic factors, such as lack of time, inconvenience of LLL-activities with respect to time and place of the activities, cost of LLL-activities and lack of employer support.

The finding that younger people are more engaged in informal learning than older—more experienced people—is consistent with Tikkanen (2002) and Kremer (2005). This may be viewed as surprising, as it might seem logical that older people

would be more interested in personal development that is not necessarily directly related to their work, for example, in the sphere of improving the quality of life in such areas as health, wealth and culture. Livingstone (1999) shows in this respect that older individuals tend to undertake more individual (rather than social) forms of informal learning. However, our results might be due to the tendency Tikkanen noted that young people see working as learning. They feel that they need to gain experience in their job, and a large part of acquiring this experience induces informal learning activities, such as working alongside others, tackling new and challenging tasks (Eraut 2004), mentoring, coaching and networking (Cheetham and Chivers 2001; Marsick and Watkins 1990).

Other personal characteristics which influence informal learning are educational level and position in the labour market. Our research confirms that those with higher levels of formal education are more likely to participate (Brunello 2001; Desmedt et al. 2006; Livingstone and Stowe 2007). This can be explained by their recognising that every form of additional education gives a cumulative advantage to those with more education, while those with less education perceive additional education as bestowing fewer advantages (Wößmann and Schütz 2006). Moreover, informal learning might even carry social and psychological risks to lower educated individuals, since they might lose connection to their social class (Desmedt et al. 2006).

With regard to the link between hours worked per week and informal learning, we found no significant relationship in our sample. Note that the distribution of employment hours in the Netherlands is similar to the distribution in Canada, with 30–39 hours and 40 hours as two major groups. However, in Canada the group of people that worked 50 + hours was substantial (19% in 1998 and 25% in 2004), whereas in the Netherlands we find that only 3% of the people works more than 50 hours. Our findings support Livingstone and Stowe (2007) who report that those who work fewer hours are no less reliant on job-related informal learning than full-timers. They only find weak associations between hours of paid work and participation in informal learning, and the relationship only holds for one particular time frame.

With regard to perceived benefits of time spent on informal learning activities, we found no positive association with perceived career success or self-reported occupational expertise. The cause for this might lie in the time lag between: (1) engaging in informal learning activities, (2) actual learning taking place and (3) experiencing career benefits from learning. It is likely that individuals who are highly engaged in informal learning, do so simply because they want to improve their career success and occupational expertise. Hence, they feel that these indicators are not yet at a satisfactory level.

Barriers to participation in informal learning activities in our sample predominantly stemmed from extrinsic factors such as lack of time, inconvenience of time and place of LLL-activities, cost of LLL-activities and lack of employer support. This indicates that respondents feel that participation in informal learning activities must fit the responsibilities concerning work and family as well as other interests and obligations. In the questionnaire, respondents were told that informal learning is learning from daily life activities related to work, family or leisure which is not structured (in terms of learning objectives, learning time and/or learning support).

Hence, it is actually not possible that there is not enough time, that the time and place is inconvenient and/or that the costs are too high. We feel, thus, that though this was explained, that they still interpreted informal learning as being tantamount to formal learning when asked about barriers encountered. This signals that the general population/labour force still does not recognise what informal LLL is and still sees LLL as being something akin to lifelong or continuing education; that is something you do at a certain time and place.

An important managerial implication of these findings is that they generate a general awareness of the crucial input of informal learning for professional competence. Managers should be aware of the limitations of formal training programmes and acknowledge that much learning takes place in an informal way, for example, through observation and copying of senior, more experienced colleagues. It is important for organisations to focus on developing and stimulating learning skills in order to enhance informal learning and facilitate its taking place. Also human resource departments should be aware that when recruiting employees, it is important to assess their affinity to learning and find out whether they are willing to continuously improve (i.e. invest in) themselves. Furthermore, it is possible to help young inexperienced workers maximise their informal learning potential by placing them in a situation where there is much to learn. For example, an organisation could place "young potentials" in positions that provide post-qualification experience. In order to stimulate LLL, managers should encourage and create possibilities for employees to explore a wide variety of learning experiences including mentoring and coaching trajectories, sounding-board activities, external practice placements and working in collaborative team projects. As employees and their learning styles differ, personalised and flexible learning packages have a greater potential for encouraging and realising LLL than fixed, standardised trajectories. It is also important to help employees become self-directed learners, skilled at getting the best out of all learning opportunities available (see also Cheetham and Chivers 2001). External barriers to learning can be eliminated through fair reward strategies enabling managers to fully comprehend the value and reasons for LLL and development (see also McCracken 2005, for additional ways of remedying barriers to learning).

Policy implications of this study lie in recognising that policy makers should consider how to best stimulate informal learning as an approach to positively impact LLL in the adult labour force in addition to formal educational initiatives currently employed. Furthermore, policy makers can be the driving force behind the development and implementation of systems that acknowledge experience, and informally acquired skills and qualifications gained by individuals. This could be of special importance for local unemployment offices that try to assist unemployed workers in finding a job.

Though this research presents nothing less than a giant step in understanding the magnitude of participation of the Dutch labour force in LLL and the perceptions that they have related to informal LLL in the Netherlands, the major limitation is that it is purely descriptive and correlational. As such, it provides a basis for policy but also for further research that is more causal in nature. This will, in turn, lead to better decisions as to how LLL can be implemented and used for innovation, economic growth and

social-cohesion, in conjunction with the transformation of Dutch production workers into knowledge workers. Further research, however, should adopt a methodology and approach which allows for regression analysis to provide more insight into the factors that stimulate LLL as well as the outcomes of LLL activities. Preferably, a research design should adopt a more in-depth longitudinal perspective. LLL activities as well as the perceived value of LLL and the barriers to it should be monitored over time. This approach could provide further insights into the changes in LLL behaviour of adults and how policy decisions and interventions affect it.

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Chapter 8
Improving the Involvement of Higher Education Institutions in Learning and Innovation in a Regional Framework

Herman van den Bosch and Marjolein Caniëls

Introduction

On many occasions, politicians as well as scientists warn that the leadership in economic development is shifting from western countries towards India, China and a selected group of South American countries. In spite of this, the European countries continue to be at the top of investments in science, and the scientific output (publications, patents) invariably belong to the world's best, although in some countries (for instance the Netherlands) the public investment in education is lagging behind. The fact that investments in academic research do not necessarily result in innovation is termed as "innovation paradox". Innovation is rooted in the search of agents for continuous improvement of their organization's core competences. Research in higher university institutions will only contribute to this goal if it reaches these agents. The general picture is that government, business and education lack alignment (Huijts 2003; Lagendijk and Rutten 2003; Nieuwenhuis et al. 2003; Storm 1986; Wetenschappelijke Raad voor het Regeringsbeleid 2008). Most European universities prefer research, for which the problem formulations result from debate between scientists and are therefore not connected to innovations in business or other organizations. Morgan (2007) is widely cited when he metaphorically refers to universities as "cathedrals in the desert".

Companies also have their share in the blame for the "innovation paradox". The willingness of companies to invest in long-term research programmes has disappeared in recent decades. The main cause is the emergence of shareholder value as a standard for business behaviour. The quest for a short-term return on investments limits the value of innovation to a more efficient production and to lower prices, instead of the development of new and better products (Dankbaar 2004).

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The Dutch "Innovation Platform" offers a detailed description of the impact of the "innovation paradox" in the Netherlands (Innovatieplatform 2008). The mediocre position of the Netherlands regarding innovation concerns nearly all aspects: specialized R&D companies, technological innovation in manufacturing and service companies labour in high-tech products manufacturing, turnover in technologically innovative products in industry and service and innovation in small and medium-sized enterprizes (SME). Patents are the only exception. According to the "Innovation Platform", entrepreneurship and competitive power in the Netherlands lag behind. On average, profits and productivity in the Netherlands is lower than in many other EU countries. In addition, the number of working hours and labour participation is decreasing. Finally, the number of students in science and technical studies in the Netherlands is limited.

The above introduction raises two questions that will be dealt with in this chapter. The first question is how innovation can be stimulated and how it is connected to regional development. The second question is how higher education institutions can contribute to innovation, without losing their academic mission. The first question is elaborated in Sect. 1; the second question is dealt with in Sect. 2.

Innovation: Developing Core Competences in (Regional) Networks

According to the World Bank (2007), investments in education and continuous learning have outranked labour, capital, and even knowledge as assets for innovation. Economic performance does not depend on what we know individually and collectively in the first place, but on our individual and collective ability to learn. In the recent innovation literature, this view is accentuated time after time: 'Innovation is a community-based "collective learning" process' or "innovation is a complex, multifaceted socio-technical process that is fostered by interactive learning" (Gustavsen et al. 2007).

Collective learning within organizations or organizational learning refers to the processes that enable an organization to develop its core competences in order to keep them aligned with external developments (Bowen et al. 1994; Cohen and Levinthal 1990; Garvin 1993; Leonard-Barton 1995; Senge 1999). Consequently, learning organizations are ". . . organizations where people continually expand their capacity to create the results they truly desire, where new and expansive patterns of thinking are nurtured, where collective aspiration is set free, and where people are continually learning to see the whole together" (Senge 1999). These organizations are ". . . skilled at creating, acquiring, and transferring knowledge, and at modifying [. . .] behaviour to reflect new knowledge and insights" (Garvin 1993). Bell and Pavitt (1993) distinguish five main types of efforts to accomplish these goals: staff training, staff hiring, in-house technological improvement (including R&D) and external search for information about new technologies and markets, and gathering internal feedback about

performance. McEwan and Ennals (2007) stress that the promotion of a "learning culture" requires new management and working practices, like participation, teamwork and democracy.

Recent insights stress that innovation does not stop at the company itself (Bessant et al. 2003). Firms operate within value streams involving many firms in supply chains within a supply network (Volberda 2004). Studies in this line of research emphasize the advantages for firms that result from interaction with their trading partners. Business partners are important providers of information and knowledge to a focal firm. Interactions with suppliers, intermediaries, customers and other firms and organizations promote organizational learning (Freeman 1994; Garvin 1993; Kraatz 1998; Lundvall and Maskel 2000; Mohr and Sengupta 2002; Von Hippel 1988). This is in line with the "relational view of the firm": buyers and suppliers systematically share knowledge and information with each other and make relationship-specific investments in return for benefits that can only be gained by working together (Dyer and Singh 1998; Jones et al. 1997; March 1991; March and Olsen 1976). During the last decade of the twentieth century, authors like Michael Storper (2007), Richard Florida (2007), Bjorn Asheim (2007) and Kevin Morgan (2007) paved the way for related concepts such as "learning region" and "regional learning clusters" (Rutten and Boekema 2007).

Based upon a series of empirical studies, the Organisation for Economic Co-operation and Development (OECD) report "Cities and Regions in the New Learning Economy" demonstrates the role of regional networks in the diffusion of innovation (OECD 2001). The European Centre for the Development of Vocational Training (Cedefop) also published an inventory of "emerging average cases" of innovative in regional (learning) networks (Gustavsen et al. 2007).

The idea of innovation as "collective learning" in an inter-organizational setting emerged after the collapse of previous ideas regarding innovation as something that is in the first place imported from outside or which resulted from intra-firm activities, such as R&D. In contrast, structural embeddedness, the mobilization of indigenous forces or use of the existing business stock became central issues in debating innovation and regional development (Bellini and Landabaso 2007). The limited opportunities of external investments, together with a growing doubt about its effectiveness resulted in a new approach, which was termed the "indigenous turn" in thinking about regional development (Lagendijk and Rutten 2003). In Table 8.1, the "old" and "new" approaches are compared.

Empirical analyses support the idea that innovations usually develop in specific environments, due to the existence of knowledge spill-overs. The existence of knowledge spill-overs is first of all related to proximity. However, others have added concepts such as "social capital" or more specifically "relational capital" in order to reveal the underlying processes.

Social capital is the sum of relations among agents, based on social institutions that allow for cooperation (incentive alignment) and communication (cognitive alignment). Social capital is responsible for the creation of markets and social frameworks that allow businesses to connect and learn (Amin and Thrift 1995; Lorenzen 2007). Capello and Faggian (2005) focus on "relational capital". This is a set of

Table 8.1 A comparison of the old and new approach in regional development

Policy trends	Old approach	New approach
Regional policy	Redistribution to lagging regions	Building competitive regions (smaller companies)
Science and technology policy	Financing single-sector projects in basic research	Financing collaborative research, involving networks with industry
Educational policy	Focus on teaching and pure research	Closer links with industry, joint research, specialization
Industry/enterprise policy	Subsidies to firms	Addressing needs of firms groups

all relationships—market, power and cooperative—between firms, institutions and people, which stem from a strong sense of belonging and a highly developed capacity of cooperation that is typical of culturally similar people and institutions. The development of social and relational capital takes time and involves education, socio-political institutions and trust.

Cooke (2007a) stresses that cooperation between knowledge-generating institutions and firms or public organizations that commercialize this information is the main trigger for regional development, which raises the question whether and why the universities are willing to participate. This question will be answered in Sect. 2.

For the present, we conclude that the main driving forces behind innovation are interaction between companies, organizations and the government in a regional framework in connection with social and relational capital. These interactive processes imply a continuous exchange of information and development of knowledge, which results in improved core competencies.

The classical example of this interactive process is "Silicon Valley", which was an empty region that transformed itself into a prosperous region within a few decades. Key success factors were: (1) the presence of innovative, creative and competent people, who were willing to take risks; (2) the availability of (venture) capital; (3) an atmosphere of tolerance that reduced the threshold of collaborative work and formed loosely connected networks and (4) good luck and chance. Government only played a limited role (Malecki and Hospers 2007).

Other examples of comparable, but never identical processes, can be found among others in Baden-Württemberg, Toulouse and Bordeaux, Uppsala, and Emilia Romagno. In the last region, 28,000 small and medium-sized companies have created networks and they engage in open innovation with the support of six universities (Bardi 2007). The most successful regions have a certain degree of specialization, referred to as "related variety". The production of a flexible mix of products that are related to each other's supply chains result in an increasing sustainable growth than linked production processes within vertically integrated firms. Authors agree

that loosely connected networks, characterized by "weak ties" are most powerful in business, because of their adaptive capacity (Boschma 2005). It is also for this reason that many large companies are in the process of dissolving into smaller companies. Companies seem to prefer strategic alliances instead of mergers.

In regional development, a balance has to be found between the supply side and demand side in the exchange of information (Cooke et al. 2004). The institutional creation of sources of knowledge and training of highly qualified labour are on the supply side. On the demand side, there are productivity systems like firms and organizations. Bridging the gap may result in innovative support organizations, such as skill agencies, technology centres, technology brokers, business innovation systems, higher education institutions and venture capital systems.

The exchange of information between neighbouring companies and other organizations and the subsequent development of core competences is summarized in the concept of regional learning. What happens is that actors in firms and other organizations interact in a spiralling process between exploring and exploiting knowledge. In this process tacit knowledge is shared and transmitted and consequently merged with explicit knowledge (Bellini and Landabaso 2007; Cooke 2007b). This process is described by Nonaka and Konno and its smooth organization is at the root of the exchange between formal knowledge and innovation (Malecki and Hospers 2007). This learning is by no means a linear process (Morgan 2007). The outcome of the process depends on the intensity and richness of the interaction between agents within a region or in a global community of practice (Oerlemans et al. 2007).

In the next paragraph, we will explore the relationship between regional development and regional learning and its institutional roots in greater depth.

The Role of Higher Education Institutions in Innovation and Regional Development

Innovation is the continuous development of core competences of companies and organizations. Innovation and regional development are fostered by the geographical proximity of companies and other organizations and the availability of social and relational capital. The second question to be answered in this chapter is the role of higher education institutions in innovation and regional development. As stated in the introduction, the partnership of higher education institutions in regional learning networks is not obvious.

Many empirical studies have been published about "key economic performance indicators" of higher education institutions, such as employment, backward linkages, multipliers and purchasing power. Without any exception, these studies reveal that universities have a large impact upon regional growth. However, this specific impact is not the object of our current interest. Keane and Allison (1999) mention two other lines of studying the impact of higher education institutions: (1) the contribution to the knowledge economy and (2) the integration in learning regions. Other authors follow this train of thought (Chatterton 2000; Chatterton and Goddard 2003; Drucker and

Goldstein 2007; Glasson 2003). This section is devoted to the latter kind of impact, which is less obvious than the former (Huijts 2003; Nieuwenhuis et al. 2003). In the first place, many universities communicate with other universities, instead of participating in networks with stakeholders in their own region (Goddard 1999; Thanki 1999).

In the 1980s, the pleadings for a deliberate role of higher education institutions in regional development increased. In the former section, we stipulated the growth of the network economy. In the network economy, a new role is attributable to the universities, that is to say, extracting economic and competitive benefit from knowledge production (Castells 1996). For stakeholders that work together in regions, the importance of knowledge of the local social and economic fabric has increased and they eagerly view the position of universities. At the same time, universities have embraced epistemological thoughts that emphasize the importance of situational over general knowledge (Brown and Diguid 2001; Brown et al. 1989).

During the last decade of the twentieth century, higher education institutions started to show a growing willingness to be a partner in formal and informal regional development initiatives, instead of maintaining an "ivory tower" position. The unprecedented growth of the number of students of their own region, the search for additional financial resources and the emergence of new types of universities facilitated this process (Charles 2003). In addition, a number of new universities were discontinued in the underdeveloped regions that considered themselves as participants in the process of development, welcoming the available public funds for this goal (Glasson 2003; Ruivo 1994).

In the United Kingdom, the Labour government invited universities to contribute to the development of the country's regions as from 1997 (Lawton Smith 2003). Cooperation in the field of research between universities and regional bodies was encouraged in a series of White Papers (DTI 2001; DTI and DfEE 2001). Universities that choose to be involved qualify for financial support by HEFCE. In particular, the "Cluster policy steering group", directed by Lord Sainsbury, has contributed to this goal by clustering groups of industries and universities. Regional Development Agencies have a mandate to involve universities in regional plans. These agencies, first of all, cooperate with "modern universities" (former polytechnics), primarily because of their receptiveness.

In the United States, regional ties traditionally have been stronger, because of the system of "endowments" and the "land grant" tradition, reinforced by the Bayh-Dole Act in 1980.

In other countries, the government has established universities with an explicit regional mission, for instance the Hautes Ecoles Spécialisées in Swiss. During the period 2004–2008, South Korean government invested 14 billion dollars in the enforcement of the regional impact of higher education institutions. More than 100 institutions participate in the New University for Regional Innovation. The Centre of Expertise programme in Finland (turnover: 500 million €) and the Poles of Competitiveness in France are also worth mentioning. Elsewhere, universities and local institutions have discontinued specialized institutions; for instance, the "Centres of Knowledge" in the North East of England are supporting the small and middle firms

in the first place. The Georgia Tech's Economic Development Institute offers the most influential programme in the United States. Monterrey International Centre of Knowledge (Nuévo Léon) is associated with Monterrey Tech University and has many regional ties.

The increase of the number of university–business partnerships raises the question of the potential impact of this policy. A growing number of studies have collected empirical evidence.

According to Dahlstrand, who has studied the Gothenburg Region, the contribution of higher education institutions to regional development in the first place lies in the creation of "configuring clusters of capabilities" (Dahlstrand and Jacobsson 2003).

Glasson (2003) has compared the regional impact of Oxford Brooks University and Sunderland University. The impact of the latter university exceeds that of the Oxford Brooks University. This relates to the unintended influences that result from multiplier effects and spin-offs, but also to the intended impact, thanks to consultancy, collaborative research and "placements" (Glasson 2003).

Research in Canada in order to reveal the impact of 11 "high-tech clusters" demonstrates that the university did not act in any case as a "driver". Instead, universities acted as a "catalyst". The large impact of Calgary and Waterloo cannot be attributed to the policy of these universities, but to the entrepreneurial behaviour of the students (Doutriaux 2003).

The University of Alborg is also a substantial "catalyst", which is in the first place related to its project-based educational system. During the past 35 years, students have carried out more than 100,000 projects together with local firms, institutions and organizations (Puukka 2008). This list is all but complete. There are many other impact studies: the university has considerable impact on regional development in the Jyväskylä Region in Finland. Monterey Tech University (TESM) in Nuevo Léon (Mexico) has contributed to regional development in an impressive way, among others through its 700 community centres of learning. Another example is the delivery of professional services by Karlstadt University in Värmland (Sweden). The four universities in the North East of England work together in an organization called Universities for North East (Unis4NE; Goddard 1999).

Table 8.2 is a summary of the activities by which higher education institutions can contribute to regional learning and innovation, as revealed in the above-mentioned studies (Glasson 2003; Goddard 1999; Keane and Allison 1999; Rosenfeld 1997)

Goddard (1999) has carried out large-scale research in the regional impact of universities. He studied the embeddedness of higher education institutions in 14 regions within 12 countries. More in particular, he focused on the "third role", the deliberate contribution of universities to regional innovative processes, the degree of participation of scientists in collaborative projects with the industry and the broader involvement of universities in the development of social capital. Growing regional ties have become visible within almost all studied cases, but at the same time, many opportunities have remained underutilized until now (Goddard 1999; Puukka 2008). For Etzkowitz, the degree in which universities, industry and government (the "triple helix") are interwoven will generate regional growth and will change the character

Table 8.2 The contribution of higher education institutions to (regional) learning and innovation

	Activities
Knowledge creation through research	• Regionally focused research • Exploiting existing knowledge by offering consultancy services • Collaborative centres where university staff and personnel from companies carry out joint research at so-called third places or academic workplaces
Education	• Stronger regional focus on student recruitment • Education programmes developed/adapted to meet regional skills needs • Development of regional learning centres/Lernladen • "Placements" within the regions for alumni in order to prevent them from leaving
Contribution to social, political and cultural life: community development, architecture, social cohesion, creation of social capital	• Enterprise development, academic entrepreneurship or spin-offs are a source of new firms, revenues and jobs • Collaboration with (regional) public and private actors, i.e. formal and informal participation as an institutional actor with other regional actors in linkages networks of learning, innovation and governance • Provision of information and analysis to support decision-making and brokering networking between national and international contacts and key regional actors • Skills transfer, by participation in community development and lifelong learning and making the university premises available for local activities

of each of the "helixes", for instance, the emergence of entrepreneurial universities (Etzkowitz and Klofsten 2005; Etzkowitz and Leydesdorff 2000; Etzkowitz et al. 2000). The concept of the "triple helix" is broadened by that of the "committed university". This approach stresses the willingness of universities to be part of a regional network depending on whether its impact will be broader than the economic benefit for regional industry (Hicks Peterson 2009; Holland 2001)

A very interesting case study about the regional engagement of a university (The role of Trent Polytechnic in Nottingham) reveals that the willingness to cooperate was influenced by the preference of either a technical-rational paradigm or a "discursive" paradigm. In the first paradigm, university–industry ties are dominated by measurable economic growth perspectives. In the latter, the focus is on the contribution of the university to social capital formation. The current policy, including university authorities, favours the first approach; the academic community prefers the second approach (Totterdill 2007). The dependence on the willingness of universities to participate in "regional growth programmes" with broader goals than economic goals, is illustrated in Sweden. The government has created governance structures that anticipate the challenges of complex and diversified regional problems within

a globalizing economy. Unlike the UK case, this policy is based upon a "culture of trust and cooperation" that is rooted in social capital by mobilizing a broad array of regional partners. Here 29 of 39 universities have become active participants in loose networks of "civic society actors and interests" (Hudson 2006).

Impact studies in general demonstrate conditional beneficial effects of active university partnerships. Below an overview of conditions is given, which has an influence on the efficacy of the role of higher education institutions in regional networks.

- Regional connectivity has to be part of the strategic policy of higher education institutions, as for instance, Alborg is greatly involved in the educational project-based system.
- Higher education institutions, and in particular its faculty, must feel "commitment" to the social and cultural "fabric" of the region. Formal relations require the existence of informal networks (Thune 2007).
- Sources of knowledge have to be made available to end users, which requires a great degree of sensitivity to the needs and requirements of end users, among other things.
- Communication with end users must be available, for instance, within specialized institutes with low thresholds ("Lernladen") or virtual discussion lists.
- Active participation in networks is preferable to market-based relations (Huggins et al. 2008).
- The readiness of individual stakeholders within institutions and the quality of their personal relations (D'Este and Pate 2007; Fromhold-Eisebith 2002; Ramos-Vielba et al. 2010; Schartinger et al. 2001).
- Management of expectations: in the first place higher education institutions are not developmental agencies.
- Cooperation within local networks involves many stakeholders. The success of collaborative programmes puts great demands upon the qualities of the project management (Rosenfeld 1997; Tomes and Phillips 2003).

The characteristics of the region are another source of differences upon the impact of higher education institutions; in fact regional characteristics act as moderating variables, Huggins et al. (2008) have done significant research in the United Kingdom (Fratesi 2004; Huggins and Johnston 2009). They scrutinized the relation between "traditional" universities and "modern universities" on one hand and competitive and less competitive regions on the other hand. Their research revealed that "traditional universities" are on average located more in more competitive regions. Their "value adding capacity" on regional growth outnumbers that of modern universities by 200%, while formalized cooperative networks generally have less meaning. Modern universities, which on average are located more in less competitive regions, receive relatively more financial resources from the region than traditional universities. However, this money in the first place comes from governmental sources. These universities operate more frequently in institutionalized regional networks. Nevertheless, their impact lags behind that of traditional universities. The reason is that the weak socio-economic structure of the regions prevents them from exploiting the existing knowledge sources (Fratesi 2004). Consequently, modern universities are

looking for partnerships within and without "their" regions. More generally, Power and Malmberg (2008) conclude that the impact of a world-class university upon its region in general will be larger than the impact of its integration into the regional network. These insights lead to a cautious conclusion, namely that an active role of higher education institutions in regional networks probably has a larger impact within average and below average competitive regions.

The most difficult problem in the development of regional networks is the bridging of the difference between university and industrial research and the ultimate solution of the innovation paradox (North West Science and Daresbury Development Group 2001). Knowledge that is produced in academic research answers questions that have come up in theoretical discourses within a specific discipline (explorative knowledge). The knowledge that is required in innovation has to contribute to the development of new products, services or ideas (exploitative knowledge). Its format differs, but not necessarily with regard to the dimension "fundamental—applied". Many theories have been highly valuable from an applied perspective; e.g., consider Archimedes, Newton, Einstein and many others. Knowledge that answers practical questions will not be limited in the first place to one discipline, which contributes to its complexity. The problem is that the processes that result in academic knowledge are separated from processes resulting in knowledge that contributes to the use of innovation. This observation was at the root of the movement towards "joint research" or "mode 2" research, whereas "mode 1" research equals "standard" university research (Gibbons 1994; Nowotny et al. 2001). The difference between both "modes" is related in the first place to the organizational framework in which it takes place, instead of new scientific methods.

"Mode 2" research takes place in the context of application: Local actors (companies, institutions, governmental bodies, community initiatives) are involved in the definition of research projects, implementation of the research and formulation and implementation of the conclusions. In addition, researchers from several disciplines work together. In "mode 1" research, problems are formulated and solved in a context governed by the academic interests of a specific disciplinary community. Consequently, insofar as research is part of the contribution of a higher education institution to a regional network, this institution has to adapt to (part of) the organization of its research in order to comply with the needs of partners in the network, and at the same time it has to maintain the scientific level of its research.

The ultimate step towards the embeddedness of higher education institutions in the region and the transition of the region into a "learning region" is the emergence of the "Mode 2 university":

- It is closer to the government and market/immediately responsive to national and regional needs in teaching and research;
- Research in interdisciplinary fashion/economic and social relevance;
- Interactive/networks/key player in evolving systems of regional and local governance;

- It is open to the market and education for the labour market;
- Entrepreneurial, reflexive and innovative (Harloe and Perry 2004).

An example of a university that is transforming itself into a "Mode 2" institution is Jyväskylä University of Applied Sciences. Seven professional programmes have been transformed into nine multi-disciplinary "Centres of Expertise", which serve regional needs. Eight of the 29 balanced score card indicators of this institution are associated with regional embeddedness.

The question how to bridge "explorative" and "exploitative knowledge" has a central position in the recent report of the Scientific Council for Governmental Policy (WRR) in the Netherlands. This report also seeks strategies to reduce the impact of the "innovation paradox". This Report argues in favour of the foundation of "Third Spaces". These are centres where collaborative research of universities, companies and other societal institutions will take place. These "Third Places" are supposed to be independent of universities and industries in order to guarantee committed but independent research. Seven so-called "Academic Workplaces" have been founded within the field of health sciences. One of these "workplaces" is associated with the Faculty of Management of the Open University in the Netherlands. Here policy questions regarding the health assurance companies are answered, using knowledge about supply chains, economics and health sciences. Researchers are staff members of assurance companies with an academic background and interest; so-called academics-practitioners and faculty members. The research output has to comply with the same criteria as "mode 1" research.

Conclusion

This chapter had two targets. The first target is to increase our understanding of innovation and the way it is related to the regional development. The second target is to obtain an insight into the role of higher education institutions in innovation and policies to increase this role.

Innovation is the development of an organization's core competencies in accordance with changing demands in its environment. Former explanations of innovation stressed intra-organizational processes, and implied a planned progress from research into development, implementation and production. The underlying assumption of the linearity of this process proved to be unsustainable. Innovations emerge in collaborative processes and have a highly iterative character and "learning organizations" facilitate these processes. These collaborative processes have a strong inter-organizational component. As these processes require face-to-face contacts, clusters of organizations boost innovations, especially if located in ("learning") regions that foster these contacts because of the presence of social or relational capital. Innovative companies and other organizations and regional development are highly connected. In essence, the "regional learning" is a spiralling process between exploration and exploitation. In this process, tacit knowledge is shared, transmitted

and consequently merged with formal knowledge. It is here where the possible contribution of higher education institutions might start.

Active partnership in regional networks is everything but an obvious role of higher education institutions. Most universities consider themselves in the first-place parts of an international educational and research network. However, for many reasons universities are challenged to play a more active role in the regional networks. This chapter assessed many aspects of this role that have been summarized under the headings of joint research, educational services and participation in the political, cultural and political life within the region (Table 8.2). As stated above, the merger of "tacit knowledge" and "formal knowledge" or "exploitation knowledge" and "exploration knowledge" will contribute significantly to innovation. An appropriate institutionalization, for instance, as "mode 2 research", is a requirement.

Society is transforming into a network-utilizing society, based upon permeable borders between its institutions. The future role of each institution depends on the relatedness within this network.

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Part III
Classroom Enrichment

Chapter 9
On the Effectiveness of Economic Experiments as a Method of Teaching Undergraduates

Ilona Ebbers, Klaas Macha, Hans-Jürgen Schlösser and Michael Schuhen

Introduction

Experiments in economics represent a method for teaching students economics by playing games. Recently, this method seems to have been spreading in colleges and universities. If you type in the words "classroom experiments" in a simple Google-search, you will receive as much as 7,830,000 hits. However, for a long time, the experiments have been regarded as an unsuitable research method for economics in contrast to their frequent use in sciences, engineering and psychology. One of the pioneers of classroom experiments was Edward Chamberlin, who gave an account of the first market experiment as early as 1948. With the help of a deck of cards he tried to explain to his students the demand- and cost-structures. For this purpose he created a special market structure where the subjects were not cashing out the profits. Although their earnings were purely hypothetical, students showed a higher motivation and were much more engaged in learning economic contents (Chamberlin 1948). One of his students at Harvard University was Vernon Smith who was fascinated by this method (Smith 1962). Smith slightly changed the experiment conducted by Chamberlin such that the rounds were to be repeated, payments became real cash and the market situation was given a more realistic touch. Smith devised a game situation called "double auction" where all prices for supply and demand were publicly accessible. Thus, he demonstrated that such markets would inevitably converge towards equilibrium, even if there were only a few suppliers who would

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know nothing of the market conditions (cf. Holt and Davis 1993: p. 6f). In 2002, the Nobel Prize for Economics was awarded to Vernon Smith in honour of contributions to experimental economics. Although the use of activity-based methods in economic teaching/learning processes is generally considered to have positive effect especially on motivation and is seen to be a true alternative to traditional "talk-and-chalk economics" (lecture, teaching/learning conversation), it has to be noticed that these methods lead in many cases to a theoretical depletion of teaching and instruction. A substantial cause of this is due to the fact that although many activity-based methods allow direct access to non-domain-specific competences (e.g., role playing promotes communication and conflict skills) and are often summarized under the term "key skills," the technical training comes off badly. Therefore, many activity-based methods are considered at most suitable for getting a start in teaching/learning processes of economic contents.

In general, literature on economic experiments is growing fast (see e.g., Holt and Davis 1993; Holt 2006; Kagel and Roth 1997; Schlösser et al. 2009), but little is known so far about the effectiveness of the method. In an overview of the relevant literature we have found several studies that evaluate the effect of one single experiment (e.g., Frank 1997; Gemmen and Potters 1997) and some that focus on an enumeration of possible classroom experiments (Holt 2006; Brauer and Delemeester 2001). To the best of the authors' knowledge there exists a total of three studies measuring learning progresses over time in a group of college undergraduates whereby students are "treated" in a control group design by experiments versus lectures. Dickie (2006) finds in a study with $N = 142$ college students that "integrating classroom experiments into the introductory microeconomics curriculum increases learning," and a similar result was obtained by Emerson and Taylor (2004) in a study with $N = 300$ students. On the other hand, Cardell et al. (1996) in their study with 1,800 participating students reported no significant learning effects between the groups that were taught differently.

In our study that was conducted at the University of Siegen (Germany) in the years 2007 and 2008 we share the general approach of Dickie (2006), Emerson and Taylor (2004) and Cardell et al. (1996) but modify it in several important ways. First, while the results of the colleagues are based on "principles of economics" courses, we have found it interesting to contrast this with an analysis in a "microeconomics II" course. The "microeconomics II" course is at a higher level of difficulty, since it requires knowledge of prior "microeconomics I" and the "principles" course. Its curriculum comprises inter alia the theories of various market forms, pure competition, monopoly, and oligopoly. The $N = 161$ students we have tested are not enrolled in "pure" economics programmes. Instead they follow a wide variety of BA programmes. A majority of 55.8% students study for a teaching degree for vocational college or secondary school. Only 2.6% of the students strive for a BA in Economics. The remaining students are enrolled in the BA programmes "Language, Communication, Media Studies" (29.9%) and "Language and Communication" (11.7%). Due to our focus on the "microeconomics II" courses we introduced a second modification of the well-established above-mentioned research designs. We could not use the Test of Understanding in College Economics (TUCE) (Saunders 1991) to test for the

students' differences in learning. While developing our own curriculum-based test questions, we decided to drop the pretest–posttest design and developed a series of three different small tests ($t1$ to $t3$) that students had to take during the course of the semester. The three tests were delivered as paper-and-pencil-questionnaires to the students.[1]

Our study was focusing on the following three research questions:

1. Do economic experiments in the (college) classroom have positive effects on students' knowledge of the curriculum compared to a control group taught in ordinary lectures?
2. Which of the possible manifestations of knowledge, declarative or procedural knowledge, is more affected?
3. How does the knowledge of each of the two groups develop over the time of the semester?

In accordance with Brauer and Delemeester (2001) who observe that "[. . .] the overwhelming number of games are written for the principles of microeconomics course [. . .]" and "[. . .] at the post-principles level [. . .], there are, as compared to 1994, more but, again, very few games available (thirteen instead of five) [. . .]", we developed a bunch of economic experiments for use in both college and university classrooms that are mainly computer-based and rely on a Microsoft Excel application package (Schlösser et al. 2009), that we have developed recently. We have developed the sequence of experiments keeping in mind what Brauer and Delemeester (2001) wrote:

> [. . .] even though there are some oligopoly/monopoly games in which the number of suppliers can be changed—thus permitting the potential construction of a single game to capture the three market structures crucially dependent on the number of suppliers, perfect competition, oligopoly, and monopoly—no one appears to have attempted to construct a single foundational game that, with variations on the theme, could capture almost all topics for an entire introductory course in microeconomics.

Game Software

We followed the idea of a coherent framework for learning the advanced microeconomics by constructing a Microsoft Excel spreadsheet that serves to visualize, for example, cost curves, but also offers the students the opportunity to practice and try out things for themselves. The main underlying focus is to get students to deal with the contents of the subject matter and consequently to be able to make their own decisions accordingly. The experiments we used in the "microeconomics II" course are shown in Table 9.1.

The first session started with an auction of chocolate bars.[2] The lecturer recorded all students' bids and then computed the demand curve of the class. For the remaining

[1] Since we plan to use the test questions again for a similar study, we have not added the test questionnaires.

[2] There was a big incentive for students to bid for a chocolate bar for it was lunchtime and they were allowed to eat the bar during the test session.

Table 9.1 Experiments that were used

Game	Topic	Source
1. Chocolate bar market	Demand curve	For all games: Schlösser et al. (2009)
2. Chocolate bar to sell	Perfect competition	
3. Chocolate bar sales	Monopoly revenue	
4. Winning with chocolate bars	Profit maximizing in monopoly	
5. Cournot-model	Oligopoly	
6. Bertrand-model	Oligopoly	
7. Monopoly	Monopoly	
8. Market entry in monopoly	Monopoly	

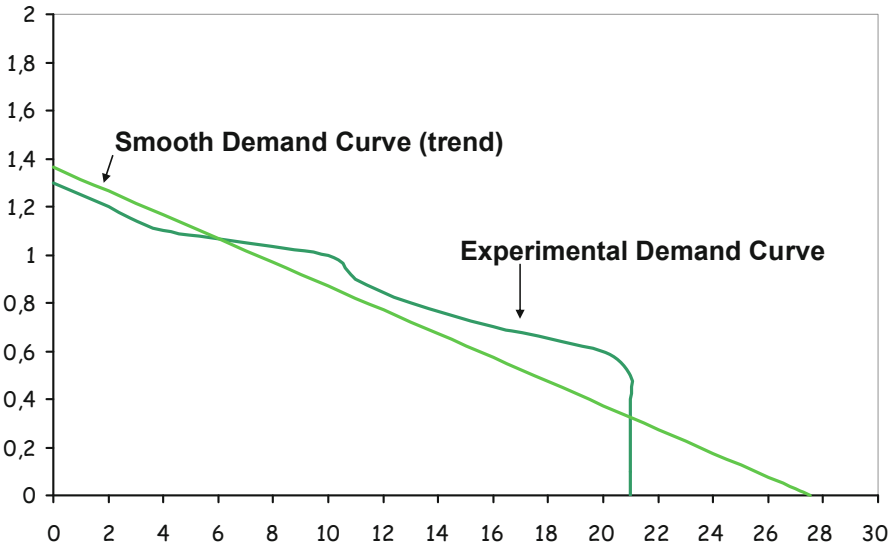

Fig. 9.1 Students' demand curve for chocolate bars

parts of the course students worked with this demand curve which they had thus derived on their own. It appeared to be motivating for them to have *their* demand curve and not one given by any textbook or a lecturer.[3] However, to stay in touch with text book economics, the software calculated a linear Ordinary Least Squares (OLS) estimation of the demand curve (Fig. 9.1).

Figure 9.2 shows an application of a students' demand curve: Calculating the dead weight loss in the monopoly case. Please note that it is the same demand curve as in Fig. 9.1, derived in the auction.

[3] This implies that each class has got a different demand curve.

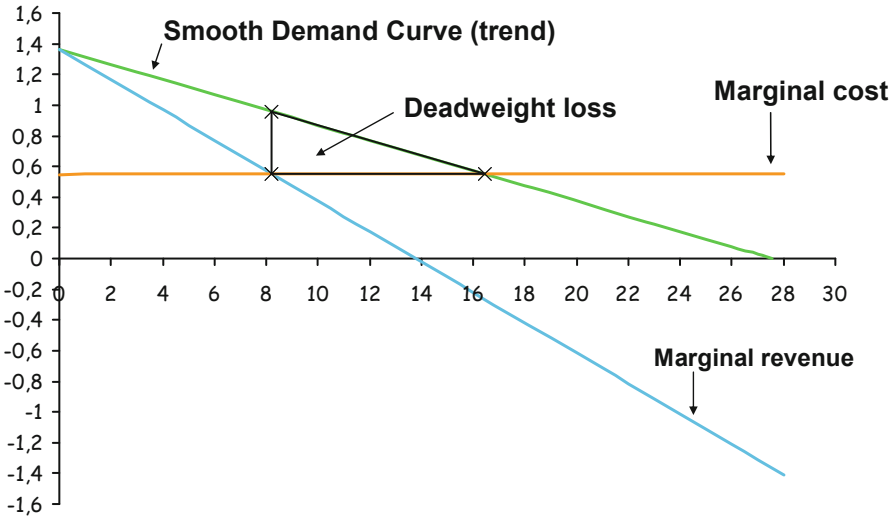

Fig. 9.2 Students' demand curve and deadweight loss in monopoly

Framework of the Study

The students in the "microeconomics II" courses of the years 2007 and 2008 ($N = 161$) were divided into two randomly chosen groups. To be precise, the group selection process was not perfectly randomized since students could make a self-selection via their inscription into the two courses. Because of the fact that students knew nothing in advance of the "treatment" they had to face and the differences in the courses, we consider the group selection process negligibly imperfect. The "experiments" group was taught the various market forms, pure competition, monopoly and oligopoly by playing games. The other group (control group) was taught traditionally through lectures.

In the relevant literature we have found a total of three similar studies measuring learning progresses over time with a group of college undergraduates while students are "treated" in a control group design with experiments versus lectures. Dickie (2006), Emerson and Taylor (2004) and Cardell et al. (1996) have all applied the TUCE (Saunders 1991) to measure differences in knowledge in a pretest-posttest design. Our approach is different in two substantial parts.

First, we could not use the TUCE, because it was primarily developed for the use in American universities. The TUCE items do not cover the curriculum that is usually taught in a German "microeconomics II" course. Since, furthermore, the TUCE can be criticized for a lack of validity and reliability (see, Becker 1997) we have chosen to develop our own test items based on the German students' curriculum to ensure curricular content validity.

Second, we decided not to use a simple pretest-posttest design such as found in Dickie (2006), Emerson and Taylor (2004) and Cardell et al. (1996) that poses the

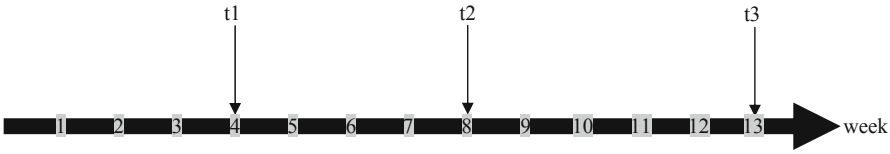

Fig. 9.3 Time structure of the tests

same questions twice in pre- and a post-test. Our reason is that for any test design repeating the same questions, it is unsure what the answering behaviour can be attributed to: The test-takers' learning through treatment or becoming more familiar with known questions. We were not only interested in the question of whether the experimental method outscores the chalk-and-talk-teaching or vice versa but also in the question *how* over the proceeding time of the semester this takes place.[4] To assess the learning advances of the two groups we applied three different small tests, one in the fourth week of the semester ($t1$), one in the eight ($t2$), and the last one in the closing week of the two courses ($t3$). Altogether the tests comprised a number of 19 items ($t1 = 7$ items, $t2 = 5$, $t3 = 7$) directly based on the curriculum being taught. The items were of multiple choice type. We have "dichotomized" the results in the sense that 1 was indicating a correct answer and 0 a wrong one as shown in the Fig. 9.3.

The tests were composed of two types of items. Declarative items measuring "pure" factual knowledge and procedural items that required the application of acquired knowledge. The "storage" of knowledge and its application activate the brain's complex memory system (cf. Anderson 2007). It has been discovered that it is necessary to apply different structures of knowledge in order to solve problems successfully. The process in place here is called "knowledge compilation" by memory researchers (cf. Gerrig and Zimbardo 2008, p. 235). These structures are differentiated into declarative knowledge ("know that") on the one hand and procedural knowledge ("know how") on the other hand (cf. primarily Ryle 1949, pp. 25–61).

"Declarative knowledge" is the factual "existing" knowledge and conscious remembering of events and facts (cf. Gerrig and Zimbardo 2008, p. 234). It comprises one's complete knowledge base and is mainly organized and categorized in linguistic concepts (Tücke 2004, p. 229). There are also visually organized concepts, for example, a photo that pictures a poor looking man lying on a bench in a park. Even without any additional information most people will automatically classify such a man as a derelict (Tücke 2004, p. 231). An example of declarative knowledge in our questionnaires is the following question in which knowledge relates to a fixed and definable technical term.

[4] We would have liked to use the students' cumulative grade point averages (GPA) or the scores on the American College Test (ACT) but there simply is nothing comparable in Germany to which we could have linked our students' performance.

Item 1: A supplier in perfect competition	
☐	Adapts quantity.
☐	Adapts his price.
☐	Is a powerful market player.
☐	Offers lower quantities than a monopolist.

"Procedural knowledge" refers to manifold possibilities to link elements of declarative knowledge. Different concepts and actions can be combined in various ways (Tücke 2004, p. 229). Procedural knowledge specifies the way things are done or, to put it differently, it describes how problems are solved with the help of various techniques, methods and algorithms (Pollock 1986, p. 129). It is used to acquire, maintain and apply cognitive and motor abilities (Gerrig and Zimbardo 2008, p. 234). Procedural knowledge is practically usable knowledge that is often realised through automated and, therefore, unconscious routines of processing. The combination of both areas of knowledge complicates the verbalisation and mediation of procedural knowledge. It is, for example, hard to describe exactly what you do when you change gears while driving a car (Gerrig and Zimbardo 2008, p. 235). An example of procedural knowledge from our questionnaires is the following "if-then-question," which requires a graphical or mathematical calculation to solve it.

Item 2: If a monopolist increases the price	
☐	Revenue decreases because quantity sold declines.
☐	Revenue increases because earnings per unit sold increase.
☐	Revenue decreases if marginal revenue is above zero.
☐	Revenue increases if sales volume is higher than the maximum sales revenue.

The distribution of the declarative and procedural test questions was the following: Test 1 and 3 each had three declarative items and four procedural ones and test 2 contained two declarative questions and three procedural ones.

Study Results

Our study population was composed of a total of $N = 161$ students of whom 97 (60.2%) were enrolled in the 2007 and 64 (39.8%) in the 2008 "microeconomics II" courses. Among the students, there were 26 (33.3%) male and 52 (66.7%) female test subjects and 83 students who did not fill out the questionnaires. Students were on average enrolled in their 4th semester and 92.3% of them had attended the preceding "microeconomics I" course. Their self-estimated knowledge of microeconomics had a mean of 3.22 on a 5-point Likert-type scale and their general economic knowledge had a mean of 3.25. Their interest in the field of economics was very high with a mean of 3.81 on a 5-point Likert-scale.

Table 9.2 Distribution of students in groups and missing value

	Lectures group	Percentage	Experimental group	Percentage	Missing	Percentage	Total	Percentage
$t1$	54	33.54	50	31.06	57	35.40	161	100.00
$t2$	59	36.65	42	26.09	60	37.30	161	100.00
$t3$	60	37.27	46	28.57	55	34.20	161	100.00

We first had a closer look at the data on item level. There are outliers indicating that the type of item—procedural or declarative—was associated with its solvability by members of the lecture and the experimental group. For example, the two items presented in the preceding Sect. 3 show a highly different distribution of correct answers, the declarative item 1 having a solving percentage of 18.52 for the experimental group and of 33.33 for the control group. We assume that this could be due to the simple declarative process of recalling the memorised definition of a supplier in perfect competition that was easier for the lectures group. The second, procedural item of Sect. 3 ("if a monopolist increases the price ...") shows the opposite distribution of solving percentages with the experimental group having 25.93 and the lecture group 7.41. This could be due to the fact that the experimental group acquired a deeper understanding of the mathematical calculations needed to solve this test question by applying the games and excel sheets.

Some items were related to students' self-assessment and to their appraisal of the course. A majority of the experimental group members stated that their learning progress was low, even those who answered all questions correctly stated the same. The members of the lecture group, even those who could not answer most of the questions, in contrast stated that their learning progress was high. Possibly many students considered a game-based learning environment as inefficient and a traditional lecture, associated with "hard work" and "suffering," as superior. Some students of the experimental group considered the lecturer as "lazy." The distribution of students in the lectures and experimental groups in the two years can be found in Table 9.2. The table also shows a considerable amount of missing values in the different tests.

The problem of missing values occurred because the tests were conducted in ordinary lessons without any prior "warning" to students. Economics courses at the University of Siegen usually do not require the students' presence at all times. To cope with the missing test values and since we consider this model as most appropriate in overall performance we have conducted the statistical analysis by using methods of psychometric test-theory or item-response-theory (IRT), more precisely by utilizing the dichotome Rasch model (originally Georg Rasch 1960; for a current presentation, see for example, Fischer and Molenaar 1995; Davier and Carstensen 2006; Rost 2003) with the help of the program Conquest 2.0 (Wu et al. 2007a). IRT- or Rasch-models are seen as generally superior to models of classical test theory and nowadays seem to have become a standard in the statistical treatment of tests. For the psychometric model we have performed three tests that were administered with two different cognitive subdomains (declaratic and procedural knowledge) resulting in a

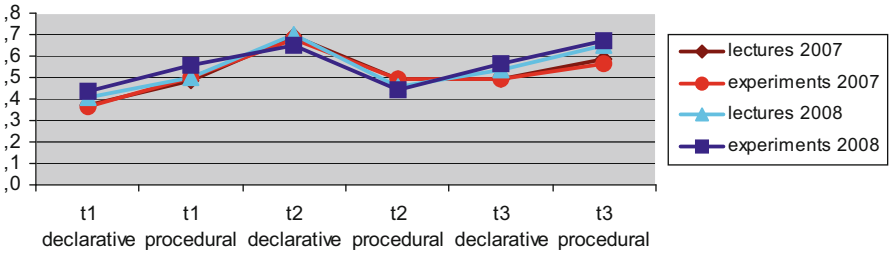

Fig. 9.4 Solved test questions percentage in a Rasch model (EAP/PV-estimator, $N = 161$)

six-dimensional IRT model (see Adams and Wu 2003; Wu et al. 2007b). The model showed an acceptable item-fit according to the criteria described in the Programme for International Student Assessment (PISA) Technical Report (Adams and Wu 2003). The deviance is 2,323.17 which is not good but acceptable for a model with only 161 participants. The very reason why we have calculated the model is to make use of the plausible values procedures included in the Conquest 2.0 framework as they represent an intelligent approach to cope with missing data. Plausible values are drawn randomly with a Monte Carlo algorithm—following the work of Mislevy (1991) and Mislevy et al. (1992)—from the marginal posterior distribution for each student and do not assume normality of the distributions.[5] Figure 9.4 shows the expected posteriori estimators' plausible values (EAP/PV) of the means of the three different tests.[6]

The curves in Fig. 9.4 are very close to each other, thus indicating that there is little to no effect favoring one of the two groups, experimental or control group. While in the year 2007 almost no difference in the two curves occurs, the 2008 testing shows a small advantage of the experimental group in $t1$ and $t3$. Part of this result is derived because in Fig. 9.4 the curves are "shrunken" together. This is a well-known feature of the EAP/PV-estimators.

Conclusion

Coming back to our research questions we have arrived at the following conclusion: First, our study shows no global positive effect of economic experiments in the classroom. So far, it is in line with Cardell et al. (1996). For the procedural parts of the test the evidence of our study is mixed but displays a tendency towards a small positive effect. Second, looking at the acquisition of knowledge of the two groups over the time of the respective semesters we can show that for the first measurement point early in the semester the teaching method "economic experiments" shows better results. Although there were no specific questions on students' motivation

[5] For details of this procedure the reader is referred to Wu et al. (2007a, 2007b).

[6] The EAP/PV-estimators were linearly transformed to a distribution that—in order to ensure comparability—has the same mean as the average of the means of the other models.

in the questionnaires this result suggests that economic experiments might better enable students to learn the course contents at an early point in the semester. A perfect curriculum that would want to implement the results of our study would therefore start with the experimental method to ensure an early commencement of the students' learning process and then switch to a larger portion of traditional chalk-and-talk lessons to allow for a more profound understanding of the field of microeconomics during the course of the semester.

We conclude that if we want to bring students to a profound and deep understanding of economic thinking and avoid pure "learning to the test," teaching with the experimental method may have advantages that should be seriously considered both in university and school teaching processes. On the other hand the experiments method is not always globally positive for students' knowledge acquisition. It must be used carefully and with accurate planning of each particular lesson through the semester. For a further clarification of this interesting field of "everyday" university life, more research is needed that extends the number of valid test subjects and spreads to other fields of economic teaching, such as macroeconomics, political economy, etc.

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Chapter 10
Integrating ICT in Business Education: Using TPACK to Reflect on Two Course Redesigns

Bart Rienties and Danielle Townsend

Introduction

The way teachers in business education—design, teach, implement and assess their courses—is changing, which can be attributed to three main developments. First, the possibilities of information and communication technology (ICT) for business education are expanding on a daily basis, e.g. ICT tools like online assessment, discussion forums, Wikis, web-videoconferencing or virtual worlds are available to everyone who wishes to use them. Research has highlighted that ICT tools can provide a rich and valuable learning experience for business students (e.g. Belei et al. 2009; Giesbers et al. 2009; Rienties et al. 2008, 2009). According to Kahn (2005), the wide availability of ICT in both educational and private environments implies a paradigm shift. This paradigm shift is not only about changes in education by implementing an ICT tool. The availability and affordances of ICT also implies a change in human relations, which leads to a different way of communication and collaboration between students and teachers.

The second development is characterised by changes in society in general, such as an increase in globalisation and individualism (Rienties and Tempelaar 2009; Van der Wende 2003), and the increased pressure on business schools to deliver high-quality education to larger numbers of students with less public funding. With the increased internationalisation of business education, competition among universities is increasingly fierce (Adcroft et al. 2010; Bok 2003). This creates several kinds of pressures on business teachers, who want to provide a rich learning experience for students even at class sizes of 400+ students.

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Third, research and evidence in business education has shown that traditional forms of education do not provide an optimal learning experience for business students. In the past, the transfer of teacher's knowledge to students was considered as a primary method of learning (Van den Bossche et al. 2004). In traditional learning settings, students have to learn the teacher's knowledge and learn by heart. However, this traditional learning method is not useful for complex tasks and complex problems in a modern society (Hmelo-Silver 2004; Schmidt et al. 2009). In particular, several researchers have concluded that traditional delivery of business education leads to ill-equipped business graduates who have limited practical management experience (Arts et al. 2006; D'abate 2010; Pence and Wulf 2009). As a result, an active approach to learning in education has become more important, whereby a teacher-centred approach is replaced by a student-centred approach (Pence and Wulf 2009; Schmidt et al. 2009; Van den Bossche et al. 2004; Wang 2009). Teachers and researchers agree that these changes in education add to a more constructivist and powerful approach to learning. This means that students learn to construct, build and co-construct their own knowledge in collaborative learning environments like, e.g. problem-based learning (PBL) (Hmelo-Silver 2004; Schmidt et al. 2009; Van den Bossche et al. 2004). Recent meta-reviews of PBL have shown that it provides a more powerful and rich learning experience for students in comparison to traditional teaching methods (Dochy et al. 2003; Schmidt et al. 2009).

Through the increasing possibilities and applications in ICT-instruments, the power of collaborative learning and the above-mentioned changes in society it is important to know how teachers can effectively integrate ICT with the content of subject-specific knowledge and the pedagogy used. As a consequence, the role of the teacher changes when ICT is integrated into education (Anderson et al. 2001; Bernard et al. 2004; De Laat et al. 2007; Mazzolini and Maddison 2003; Vonderwell 2003). The role of the teacher changes from a more product-oriented role (i.e. focusing on knowledge transfer and learning outcomes, e.g. exam) to a more process-oriented role (i.e. facilitating the development of the students' knowledge building during the course). Teachers are challenged to understand and apply digital methods as well as to create a powerful learning environment where teachers and students take responsibility for their learning (Mishra and Koehler 2006).

While a large number of textbooks and models on effective teaching in higher education exist (e.g. Biggs and Tang 2007; Nicholls 2001), only a limited number of models specifically provide a clear and intuitive model for teachers to effectively redesign their teaching using ICT. Given that a large number of review studies (Bernard et al. 2004; Lou et al. 2006; Luppicini 2007) have demonstrated that for implementing an ICT tool into education, it is imperative to thoroughly understand the affordances of the ICT tool, the appropriate pedagogies and most importantly the specific relevance for the respective cognitive domain, and hence there is a need among business teachers for a straightforward model to successfully integrate technology, pedagogy and content knowledge. Therefore, in this chapter we adopt the technological pedagogical content knowledge (TPACK) model of Mishra and Koehler (2005, 2006), who have developed a helpful model for teachers to effectively integrate content, technology and pedagogy based upon the work of Shulman (1986), i.e. in particular

specific attention is directed towards understanding how technologies can be successfully implemented in particular subject domains such as business education. In the last couple of years, the TPACK model has been increasingly and successfully used by teachers and researchers alike to successfully integrate ICT into educational practice (Koehler and Mishra 2010).

In this chapter, we will elaborate on the TPACK model of Mishra and Koehler (2005, 2006) and discuss how business teachers can use this model to rethink and redesign their teaching practice. Afterwards, using principles of design-based research (DBR) (Collins et al. 2004; Reeves et al. 2005) we will apply the conceptual TPACK model to two redesigns of business courses. Each redesign addresses the choice and the use of an ICT-tool within business education using a collaborative learning approach. In other words, in this chapter, we will discuss how these two business teachers effectively integrated technology into their course redesign and daily teaching practice.

How to Design Rich Learning Activities Using TPACK?

In a blended or online learning environment, the role of (most) teachers is likely to change in relation to his/her role in face-to-face education. Several researchers have highlighted that in a blended or online setting the teacher can be seen as a supervisor, facilitator and coach of the learning process rather than someone who only transfers his or her knowledge (e.g. Anderson et al. 2001; De Laat et al. 2007; Mazzolini and Maddison 2003; Mishra and Koehler 2006; Vonderwell 2003), e.g. Mazzolini and Maddison (2003) show that the role of the teacher is changing from a 'sage on the stage', where the teacher is lecturing and students take a rather passive role, to a 'guide on the side', where the teacher facilitates the learning process of the student. In the latter situation, the learning environment is to a greater extent shaped by the student. Therefore, leadership qualities are becoming more important for teachers next to having domain knowledge and pedagogical skills to transfer the knowledge to students. As a consequence, students and teachers have to learn to work together in a team, thereby learning how to organise, plan, coach, reflect and negotiate (Bohle Carbonell et al. 2011; Rienties et al. 2009; Volman 2005).

Business teachers who want to use ICT to enhance the learning experience of their students do not have to invent the wheel themselves. A lot of information is available on the Internet about various educational ICT-instruments, e.g. Dutch websites like www.digitaledidactiek.nl and www.surfspace.nl/nl/GoodPractices give an overview of ICT applications and their advantages and disadvantages in education. At the same time, websites like http://www.bized.co.uk/ or http://www.crossknowledge.net/ provide completely designed materials for business teachers. However, if business teachers want to use ICT to facilitate a rich learning experience for business students, then it is important to know under which conditions ICT leads to enhanced learning (Valcke and Martens 2006).

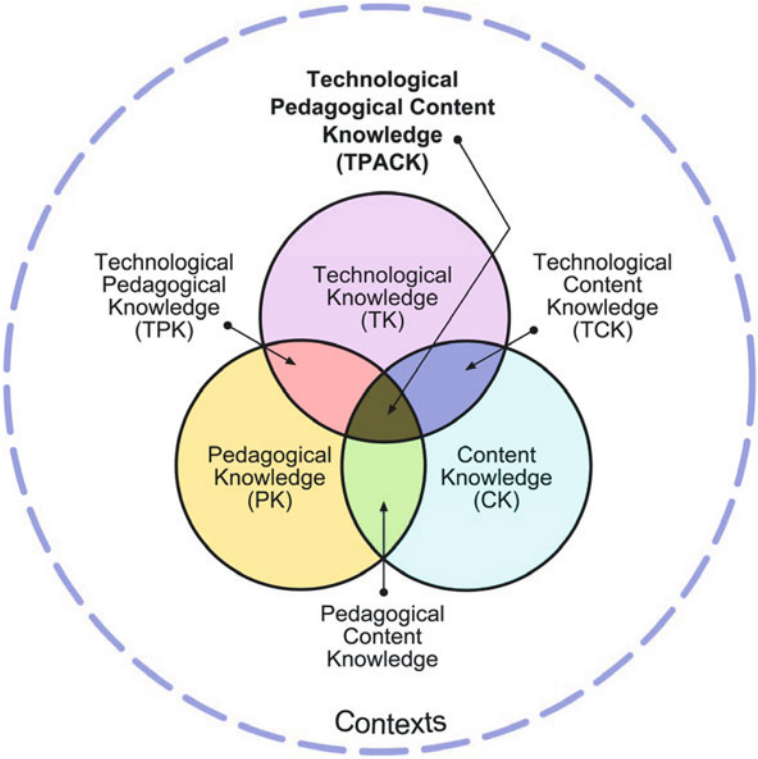

Fig. 10.1 TPACK model Mishra and Koehler (2006, 2010)

Research has highlighted that the application of ICT in education does not necessarily lead to improved learning experiences for students or enhanced learning processes, study performance or retention (Giesbers et al. 2009; Järvelä et al. 2008; Lou et al. 2006; Valcke and De Wever 2006; Valcke and Martens 2006). In fact, research has shown that the exact opposite can happen, e.g. ICT-instruments that are applied from a technical point of view, thereby not considering the learning environment, can lead to less motivation of students and less overall effectiveness of the course design (Valcke and De Wever 2006). In other words, merely the application of ICT does not necessarily have added value in education unless the implementation of ICT in education is well-designed and implemented (Mishra and Koehler 2006).

In order to successfully implement ICT it is important to adjust the content of the business course in line with the technology selected and pedagogical approach used. Therefore, Mishra and Koehler (2006) designed the TPACK model for successful education using ICT (Koehler and Mishra 2010). In line with the work of Shulman (1986), the authors show that education is most effective when content knowledge (CK), pedagogical knowledge (PK) and technological knowledge (TK) are used and when they interact with each other as shown in Fig. 10.1.

First of all, the section pedagogical content knowledge (PCK) in Fig. 10.1 reveals which pedagogical approach matches with the respective content taught in the

course. The section technological content knowledge (TCK) shows that teachers need to understand how the course content should be reconsidered when a technology is introduced to complement the course delivery. The section technological pedagogical knowledge (TPK) illustrates that teachers need to understand that the use of technology can change the way of teaching. The intersection of these three (TPACK, positioned in the middle) is the optimal integration of content knowledge, pedagogical knowledge and technological knowledge (Mishra and Koehler 2006). Here, it is clear which concepts are used in technological knowledge, how pedagogical knowledge can be used in a constructive way applying technology in order to transfer the content and how technology can be used to solve students' and teachers' problems in education.

In practice there is often an imbalance between the technological, pedagogical and content knowledge of a teacher (Mishra and Koehler 2005, 2006; Shulman 1986). Technological knowledge is often seen as independent from content and pedagogical knowledge (Kirschner et al. 2008; Mishra and Koehler 2006; Wang 2009), e.g. if a teacher decides to use a wiki to discuss effective marketing strategies in a marketing course without incorporating the technology into the course design (e.g. having a task where students have to search for effective marketing strategies and report this in the wiki), reconsidering the delivery of content (e.g. discussing marketing strategies in class) and/or readjusting the pedagogical approach (e.g. using a collaborative learning approach rather than using a traditional lecture-based approach), most likely the students will not actively use the wiki.

Furthermore, content knowledge often determines the use of pedagogical knowledge and technological knowledge (Koehler and Mishra 2005; Mishra and Koehler 2006). According to the TPACK model, technological knowledge determines the use of content and pedagogical knowledge based on the issues that teachers encounter in education. The starting point thus is an issue that the teacher experiences during teaching, e.g. low students' involvement or a low passing rate for a course. This could be solved by using an appropriate ICT-instrument that matches the content knowledge. The teacher can change the content and the transfer of content, the pedagogy, on the basis of the instrument in order to solve the problem. In this way, the teacher learns to look in a different way at the problem/the issue and the role of ICT herein—a paradigm shift.

Methods Setting

The application of the TPACK model is elaborated upon by two redesigns of business education courses at Maastricht University School of Business and Economics. Typically, education at Maastricht University (UM) is based upon the principles of PBL. PBL typically involves learners working on problems and learning tasks in small groups with the assistance of a tutor (Schmidt et al. 2009), i.e. problems serve as the context for new learning, whereby students' prior knowledge is activated (Hmelo-Silver 2004; Segers et al. 2003). Collaborative learning lies at the heart of PBL (Hmelo-Silver 2004; Schmidt et al. 2009; Segers et al. 2003). In addition, according

to Segers et al. (2003, p. 317) 'becoming self-dependent experts by working as self-dependent learners on problems is a core approach in PBL'.

Both redesigns are situated into PBL and conducted in a real, authentic setting. The first redesign describes a relatively simple redesign using ICT, whereby the teacher used frequent online assessments to ensure that students came prepared to their meetings. The second redesign describes a thorough redesign, whereby the teacher used virtual worlds (i.e. Second Life) in order to enhance the practical experience of launching a new brand into the market. By first describing the problem of the course at hand, afterwards describing the actual redesign and the changed role of the teacher, we use the TPACK model to critically reflect whether the teachers in the two redesigns succeeded in effectively integrating ICT into their education.

Design-Based Research Method

In this chapter, we will use principles of DBR in order to critically reflect on how the two business teachers have redesigned their courses by integrating ICT, i.e. the research is conducted in two consecutive steps as recommended by Collins et al. (2004). According to Collins et al. (2004, p. 21), '[d]esign experiments bring together two critical pieces in order to guide us to better educational refinement: a design focus and assessment of critical design elements'. While experimental research provides crucial insights in laboratory setting on how learners react to (small changes in) learning conditions, in real settings multiple dependent and independent variables influence the interaction of learners within the learning environment (Collins et al. 2004; Kelly 2004). Although design research is set in real educational settings where teachers want to improve the learning of their students, theoretical foundations (i.e. TPACK) and claims for design research are essential for the identification of educational problems and possible solutions (Reeves et al. 2005). According to Reeves et al. (2005, p. 107), '[t]heory informing practice is at the heart of the approach of the [design research] approach, and the creation of design principles and guidelines enables research outcomes to be transformed into educational practice'.

Results

Redesign 1: Using Frequent Online Tests to Improve Discussions in Tutorials

Reasons for Redesigning the Course

The teacher of an introductory economics course experienced that students had significant problems to cope with the demands of the course. First of all, most of the 400+ first-year students had no background in economics and therefore had difficulties in understanding the economic concepts that are discussed during the course. Research

has found that in particular international students at UM have considerable difficulties to grasp the basic economics concepts in their first economics course (Rienties et al. 2008). Second, many students have a tendency to study the learning materials just before exams rather than during the course. However, active learning approaches such as PBL require that students actively contribute during the tutorials (Van den Bossche et al. 2004). As a consequence, the learning effects that frequently occur when students are discussing economic theory during tutorials with their peers were hampered as some or most students did not prepare for the tutorials. Third, several tutors of the course indicated that students who did read the learning materials nonetheless had substantial difficulties to implement economic theory into practice due to a lack of prior education, which led to a lower level of willingness to actively contribute to the discussions. Combining these effects, the cognitive and social interaction in tutorials might be less than optimal and the overall passing rate at the end of the course was lower than other courses in the first year.

Redesign of the Course

In order to enhance the basic insights of economic theory, to encourage more participation during the tutorial group meetings and to stimulate the application of economic theory to practice, the introduction to economics course was completely redesigned. The teacher explicitly decided to create an attractive and interactive course where students had a lot of autonomy and responsibilities (Jang et al. 2010). Instead of using only learning materials from the textbook, a case study (i.e. the oil market) was used (Woltjer 2004), in which students applied the economic concepts throughout the course (PCK). During the tutorials and lectures, less attention was paid to the explanation of economic theory. In contrast, more emphasis was on the practical applications in the oil market using economic theory (PCK). As a result of the focus on the application of economic theory in practice, the order of the course topics and topics discussed changed.

In addition to adjusting the content of the course, the teacher used technology in the form of frequent online assessments to ensure that students came prepared to their meetings. Students had to take and pass at least five out of six weekly online tests (TCK) that tested the learning material that was discussed in the subsequent meeting (Rienties and Woltjer 2004), as is illustrated in Fig. 10.2. Recent research has highlighted that frequent online assessments with clear and relevant feedback can help novice students to quickly grasp and apply new theories (Brouwer et al. 2009; Tempelaar et al. 2009). Each test was constructed from an assessment database included by the publisher of the main economics textbook. On average, each test was based upon 200 questions of respective chapters discussed during the particular week, whereby 20 random multiple-choice questions (economic theory, exercise, application) were provided to a student. This ensured that it was too difficult for students to guess the answers and pass the respective test without actually studying and understanding the economic theories covered during that respective week. Each student received immediate and detailed feedback on his/her comprehension and application of the economic concepts, with further reference to the respective section

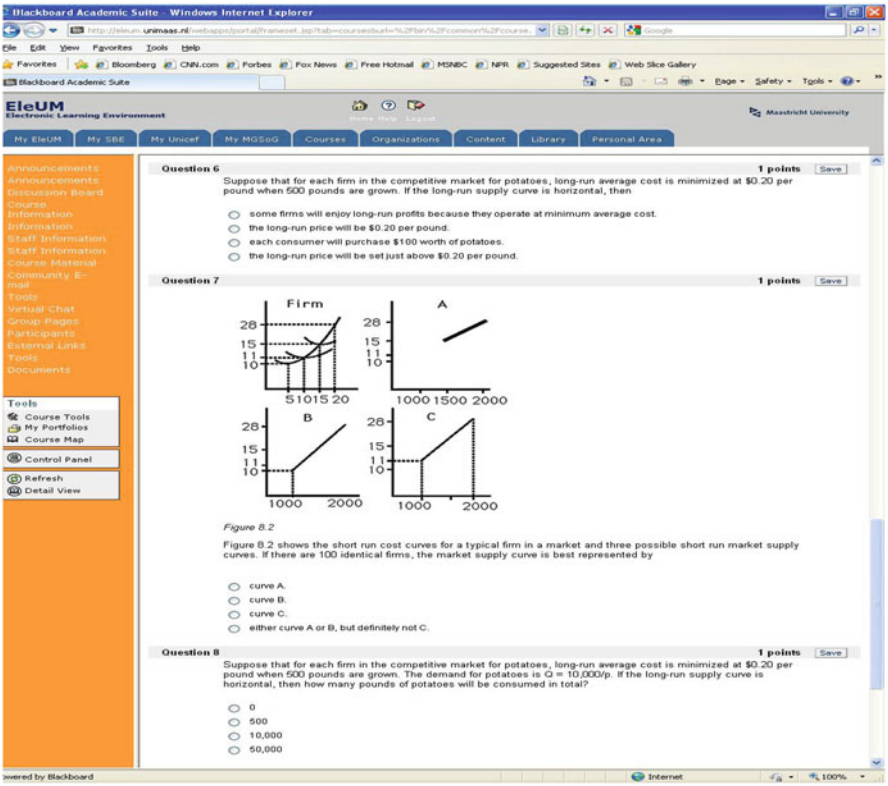

Fig. 10.2 Screenshot of a weekly test

in the textbook (TPK), which enhances the self-efficacy of students and provides additional learning opportunities when students answered a question wrong. Students could decide on the timing of the tests as long as it took place before the tutorial.

As a result, most students were well-prepared for the tutorials, thereby increasing the quality of the discussions with their peer-students. Less time was spent to explain the basic concepts (as these concepts were tested online) and there was more time available for the practical application of the economic concepts and models (TPACK). Some topics that resulted in low scores in the weekly tests were given more attention in subsequent lectures. In comparison to the old design, the students' evaluation scores of the course improved significantly and the passing rates were higher (Rienties and Woltjer 2004; Woltjer 2004).

Role of the Teacher

The redesign of the introductory economics course from a theoretical course to an application of economics in a real world setting had some impact on the daily

routine of the teacher. First of all, sufficient attention was needed to address to ensure that students understood how to make the tests and what was expected from the students before and during the tutorial meetings. Second, the teacher had to react to technical problems of students, which often occurred shortly before the deadline of the respective week. Among the 2,500+ tests made by students during the course, on average between 50 and 100 complaints from students were addressed. After the first year of the redesign, a student assistant took over the technical support of the online tests, thereby reducing the workload of the teacher. Third, the teacher used the results of the weekly tests to redesign his weekly overview lecture if particular economic concepts were poorly understood. Finally, the 10+ tutors who taught the 30+ tutorial groups indicated that more attention was paid to the application of economic theory to practice, rather than to explain to the students how particular economic concepts work. The amount of time necessary to build, support and implement the online assessment for a course was relatively low, namely an estimated 15 hours. Given that the database of questions was extracted from a standard textbook, creating the various assessments took less than 5 hours. The monitoring and technical support during the course took 30–90 minutes per weekly test. In other words, the additional workload per student for the teacher was 2.25 minutes.

Reflection

Although the redesign of the introductory economics course implied a rather simple and straightforward application of an ICT assessment tool that is currently readily available in most learning environments used by higher educational institutes, the actual impact on the learning of students was profound (Rienties and Woltjer 2004; Woltjer 2004). Due to the fact that the weekly online tests replaced parts of the traditional coverage of introductory economics topics, more time could be devoted to the actual implications of economic theory to practice. Furthermore, as students came prepared to their tutorial group meetings, the actual quality of the discussions in their groups improved, which eventually led to a higher student satisfaction and a higher passing rate. By redesigning the content and pedagogy in line with the opportunities of technology, the teacher integrated the core concepts of the TPACK model into his introductory economics course and was able to increase the passing rate of his course without lowering the quality standards.

Redesign 2: Enhancing Practical Experience of Brand Management Using Virtual Worlds

Reasons for Redesigning Course

Teachers from the second year marketing course ‘Brand Management’ (i.e. how do companies position a product/brand in the market?) at UM wanted to increase students’ practical understanding on how firms effectively manage brands. Research on

Fig. 10.3 Screenshot brand management course in Second Life (Belei et al. 2009)

expertise development indicates that graduates who start working in companies have strong theoretical skills but lack practical experience to implement their theoretical skills effectively in the work-place (Arts et al. 2006; D'abate 2010). A major problem with setting up a new brand of products in practice is that it is a costly and difficult process for companies and the ability for business students to use trial-and-error brand launches is limited (Belei et al. 2009; Belei et al. in press). However, when students develop and implement a new product in a virtual world, students can learn in a safe environment how to create a brand without being a cost-intensive investment for firms.

The Redesign of the Course

By redesigning the marketing course from a theoretical brand management course to an application of brand management theory, the teachers wanted to enhance the practical learning experience of 180+ business students. From this perspective the teachers adapted the course in order to be able to use a virtual world game (i.e. Second Life) as an instrument to experience how to effectively launch a brand into the market, as is illustrated in Fig. 10.3 (Belei et al. 2009, in press). Students had to work in small groups of 3–5 students (PK) besides the groups of 15 students, which is a typical group size used for PBL at UM. These 40+ subgroups had to apply their theoretical knowledge (CK) of brand management gained during the course to their own developed virtual brand in Second Life (TCK). Thus, a variety

of 40+ competitive companies (i.e. groups of business students) battled for virtual customers. The 40+ teams of students were given a lot of freedom and responsibility to design and position their brand into the virtual market, as shown in Fig. 10.3.

The results (Belei et al. 2009) indicate that the redesign was a successful simulation of brand management, where business students learned the integral process of positioning a brand into the market and immediately saw the results of their strategies using ICT (TPACK). In other words, the brand management simulation is an interesting and interactive way of learning where students have to participate and work together in teams, which is known to lead to enhanced learning when applied appropriately (Järvelä et al. 2008; Rienties et al. 2009; Van den Bossche et al. 2006).

During the redesign process of the course, the teachers changed the content, based on the problem statement, and re-designed the course in a way so that students had to work together in sub-groups (PCK) with a lot of autonomy and responsibility on them (Jang et al. 2010). The teachers chose a technology that matched the student's environment. Furthermore, the content covered in the brand management course was adapted to the phases of the process of positioning a product in the market (TCK). As a consequence, the order of the course subjects changed. Some subjects needed more attention due to the practical experience that students had in Second Life. Other subjects needed less attention, e.g. the subject 'competitors' was discussed less explicitly in tutorials as students experienced the pressures of brand competition directly in the virtual world. The tasks as well as exams were adjusted, i.e. rather than discussing (abstract) cases of brand management, students had to create their own product, initiate a new brand, successfully launch the brand into the market and make (virtual) profit. In addition, the assessment was changed from only a standard written final exam to also assessing the learning process in the course. This means that the group that earned the highest amount of money did not automatically receive the highest grade. By giving a presentation, students were actively encouraged to reflect on their brand management choices and had to state their reasons and the results of certain strategic choices they made.

Role of Teacher

In comparison to the first redesign, the teachers in the Second Life redesign had substantially changed their role during the course (TPK). The teachers redesigned the course, chose the instrument and adjusted it to the course (e.g. creation of an island in Second Life), placed all facilities, provided background information and technical support (e.g. helpdesk, lectures on how to operate in Second Life), motivated the students, watched the whole process and took part in Second Life together with the students. The teachers stated that adequate support through carefully redesigning the course, guidance during the course and creating fun is essential for success. The content (brand management) was determined through the technology (Second Life) and the pedagogical approach. This led to a successful and motivating course for students with much better student evaluations and study success improved considerably (Belei et al. 2009). Nonetheless, the amount of time necessary to build, support and

assess the virtual world for this course was rather excessive, namely an estimated 300 hours. The monitoring and technical support during the course took 20 hours per week. In other words, the additional workload per student for the teacher was 90 minutes, which is 40 times higher than in the first redesign described.

Reflection of Course Redesign

What is evident in the second redesign is that when using new technologies such as virtual worlds it is not only important to learn to effectively use the technology but also to look at the other two elements of the TPACK model and their interactions (Koehler and Mishra 2005; Mishra and Koehler 2006). Learning is a transformation process. It is about the development and understanding of complex relationships (TPACK). Only if teachers know, understand and are able to facilitate the complex relationships and processes, then ICT can be applied to education irrespective of the ICT instrument. Koehler and Mishra (2005) call this 'Learning Technology by Design'. The brand management teacher started with a problem or an issue she encountered in education and carefully selected and used technology to enhance the practical learning experience of business students. The course re-examined and redesigned the content, technology and pedagogy. The teacher is responsible for the results and learns to see the interactions of the three aspects as well as the application of technology in order to practice the theoretical background. A careful balance between enhanced learning and cost-effectiveness needs to be addressed in the near future to ensure that simulations in virtual worlds are efficient from a cost-perspective as well.

Discussion

In this chapter, we used Mishra and Koehler's TPACK model to critically reflect whether two redesigns within business education effectively integrated ICT into their education. For a successful integration of ICT in business education, it is important that there is a balance between the content of the course, the used technology and the pedagogy. This means that teachers need to know, understand and appreciate the three aspects (content, pedagogy and technology) as well as their complex interactions. An essential prerequisite of effective implementation of ICT into education is to ask the following two questions: Is ICT helpful in solving a particular issue in education? If yes, how should ICT, content and pedagogy be integrated in order to solve this issue in the course?

Based upon an elaborate problem analysis (i.e. past evaluations of the course, talking to stakeholders in the field or own experiences), a teacher needs to critically reflect that what is the main problem he/she wants to address using ICT (Collins et al. 2004; Kelly 2004). The course will be redesigned and all three aspects will be re-examined again in line with the principles of DBR.

In the introductory economics course, the redesign implied a relatively straightforward employment of weekly online tests. As a result, the teacher was able to provide more time in applying economic theory to practice in class. Furthermore, more time during group discussions was available to discuss the applications of economic theory in the real world, as all students were better prepared and understood the basic concepts of economic theory discussed during that session. As a result, the quality of the group discussions improved, students were more satisfied about the introductory economics course and finally the passing rates on the exams were higher in comparison to the old design. Most publishers provide similar online questionnaire databases as described in the introductory economics course, thereby allowing business teachers to redesign their course and use the richness of frequent online assessment in a similar, time- and cost-effective manner.

In the virtual world redesign, the teachers not only changed their role in the class but also actively simulated interaction in Second Life when students were off campus. The teachers were actively involved outside regular teaching hours in assisting, supervising and coaching the groups of students in their design and implementation of their (virtual) brand. In other words, the role of the teachers outside class activities changed. As was illustrated in the two redesigns, a teacher can only successfully integrate an ICT instrument in education and thereby enhance the learning experiences of students when a teacher truly understands the complex relationships between content, technology and pedagogy. Many 'innovations' in education using ICT have failed as teachers were insufficiently aware of and/or were inadequately prepared for the implications of using technology in their course (Luppicini 2007; Mishra and Koehler 2005, 2006).

The two described redesigns may be just two effective implementations of ICT at one institute. In line with principles of DBR-research, future research should continue to address how these two teachers are continuously redesigning their modules, whereas we focussed only on the design and first redesign phase. Nonetheless, recent research has found that teachers around the world design fairly similar courses when the pedagogy, content and technology used are given (Rienties et al. 2011), e.g. in a European comparison of online and blended courses, 118 course descriptions were analysed with the aim of describing their main educational scenarios used by teachers. Courses designed by, e.g. math teachers who used frequent online tests seem to be quite closely clustered in their design, implying that teachers design fairly similar courses across Europe (Brouwer et al. 2009; Rienties et al. 2011; Tempelaar et al. 2009). Similarly, the European comparison indicated that courses in business and economics apply rich collaboration among small groups of students and use fairly equivalent pedagogical approaches and technologies.

How to Encourage Innovation Among Teachers?

A crucial role in raising awareness among teachers of the complex interplay between technology, pedagogy and content is to provide adequate training and support

by management that is relevant for their practice. In particular it is important that the training provided to teachers is embedded into their daily practice. Therefore, we suggest providing training for teachers using more good-practices of their institute/discipline complemented by textbook examples from educational literature (e.g. Biggs and Tang 2007; Nicholls 2001). Most teachers are more inclined to use an effective ICT tool/pedagogy when their fellow-colleagues within their institute or discipline have successfully innovated their educating styles. Currently, we are implementing a Dutch nation-wide project for training teachers to effectively redesign their courses using the TPACK model (www.marchet.nl). The online modules provide an active learning experience for teachers. By combining teachers from different institutes, they are encouraged to share good and bad practices of ICT usage with peer-teachers. Furthermore, by implementing the course in a distance format, the awareness of teachers about the implications of ICT usage is raised. This means looking deeper into the complexity of education with ICT, a paradigm shift. Finally, within the training program teachers are required to start redesigning their respective course. The peer-group of teachers supports each other through the redesign process and helps their peers in 'rethinking' education. The evaluation of this project gives us more insights into the practical use and implications of the TPACK model and is a base for future research.

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Chapter 11
A Longitudinal Analysis of Knowledge Spillovers in the Classroom

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Literature on regional economic development reveals that innovation is fostered when firms are in close proximity to and interact with one another—and this effect is especially pronounced for smaller firms (Capello 1999; Capello and Faggian 2005). Effectively, this proximity of and interaction among firms creates a learning space for these firms and fosters processes that promote learning and innovation. Naturally, one wonders if this demonstrated phenomenon in regional economic development can provide a metaphor for helping to understand the impact of proximity and interaction of learners in a classroom. In particular, when learners are working and learning together in small teams as well as in classroom settings, we would like to explore whether proximity and ability to interact with learners and teams promotes learning.

There has been a rapid growth in the use of small groups in teaching to engage students in active learning (Decuyper et al. 2010; Lindblom-Ylänne et al. 2003; Michaelsen et al. 2002). By implementing a team-based structure, teachers aim to convert their classroom into a learning environment where students learn from and together with their fellow team members (Hurme et al. 2007; Katz et al. 2004; Lindblom-Ylänne et al. 2003; Van den Bossche et al. 2006). However, the introduction of the teams as basic learning units in the classroom questions the value of the classroom as a learning space; a space in which the different agents in the learning process—teachers and students—are together. The above-stated literature on regional economic development points to the potential value of having different learners and teams close in proximity (Capello 1999; Capello and Faggian 2005).

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Research in organisational science has found that although people within an organisation or community share geographical or physical proximity, have opportunities to interact and share similar goals, not all members and teams are willing to actively share knowledge with others (Borgatti and Cross 2003; Casciaro 1998; Haythornthwaite and Wellman 1998; Héliot and Riley 2010; Krackhardt and Stern 1988). As sharing knowledge and expertise with others is an implicit cost to an individual learner (e.g. spending time and energy to explain another learner/team, sharing a creative solution that other teams can "steal"), while the expected returns of receiving relevant new knowledge and expertise from others are unknown, some individuals are less willing to share knowledge than others (Bohle Carbonell et al. 2011; Borgatti and Cross 2003; Héliot and Riley 2010; Krackhardt and Stern 1988). Within the research on computer-supported collaborative learning, a similar trend has been found, whereby not only the willingness of learners to share knowledge within and across teams but also the actual behaviour of learners to share knowledge is substantially skewed and not a given artefact when courses are designed based upon collaborative learning (De Laat et al. 2007b; Rienties et al. 2009). Nonetheless, literature on teamwork has recently pointed out that in addition to engaging in internal learning activities, teams in organisations also must engage in external learning activities, i.e. teams should also learn from external experienced members of other teams about the task (Bresman 2010).

Within educational psychology, limited research has been conducted in order to assess whether teams also learn from the experiences of other teams in their class and what the underlying mechanisms for creating this learning space are. Therefore, in this chapter we designed a specific learning environment whereby teams were working on authentic and complex team assignments and were dependent on the outcomes of other teams. Learners interacted in both a face-to-face context as well as in an educational technology context such as WIKIs or discussion forums. Small working teams constructed (shared) knowledge and tried to reach successful collaboration in their social learning space during the 14 weeks.

The main goal of this research is to explore whether and how knowledge spillovers across teams occurred over time and how researchers may capture these spillovers using the tools like social network analysis (SNA; Bohle Carbonell et al. 2011; Borgatti and Cross 2003; De Laat et al. 2007b). In this explorative study, we want to know if knowledge is really transferred among learners (individual students and small working teams) and how this transfer occurs inside and between teams. This study does so by applying a dynamic SNA in order to understand the dynamics of knowledge spillovers within and across teams at three consecutive time measurements (De Laat et al. 2007a). Finally, by using the teacher's reflection on the knowledge spillovers across teams, we try to delve into the underlying mechanisms that may explain why some teams are more likely to establish knowledge spillovers than other teams. Therefore, the objective of this study is to provide information that would primarily be useful to researchers who are interested in examining the impact of different types of group assignments on the interactions (and the learning that results from) interactions within and between teams in and outside the classroom.

Learning Within and Across Teams: Knowledge Spillovers

When the determinants of innovation are studied, the so-called "intra firm" determinants of innovation are considered to be the main explanations of different innovation performances; in particular, the size of the firm appears to be the most important determinant (Acs and Audretsch 1993; Audretsch and Feldman 1996; Rothwell 1989). However, the empirical results of these studies identified small firms as much more innovative than larger corporations. Therefore, several researchers (Anselin et al. 2000; De Groot et al. 2001) have put more emphasis on the determinants that are external to the firm to explain innovative capacity. These external factors are named *knowledge spillovers* and refer to positive influences that firms received in terms of knowledge from the environment in which they operate.

As Geroski (1995) stresses, the proximity to other firms can be essential in increasing the innovation capacity of a firm independently of internal-firm characteristics, i.e. there is an agreement in the regional economics literature regarding the fact that physical proximity among firms plays a crucial role in improving their innovative capacity. Space matters because of the existence of knowledge spillovers. However, this space is not only physical but also shaped by the different relationships built among local actors. Capello (1999) and Capello and Fagian (2005) describe how influences from outside the firm (i.e. the local environment) foster the innovative process developed within the firm. So, following Capello and Fagian (2005), the precondition for the creation of knowledge spillovers is the *cultural proximity* of economic local actors (i.e. their sense of belonging to the geographical area, their capability of interacting and the sharing of common values). This cultural proximity is the basis for the existence of explicit and implicit cooperation among actors and public and private partnerships.

Also literature on (team) learning and knowledge management have identified how effective learners and teams engage in external knowledge sharing (Cummings 2004; Eggens et al. 2008). Research on team learning, e.g. has pointed out that when confronted with time pressure, lack of knowledge, changing circumstances and resource scarcity, teams are increasingly turning to boundary spanning in search of external sources to learn from rather than relying solely on their own experiences and knowledge (Bresman 2010; Edmondson et al. 2003). Within educational sciences, the research of Eggens et al. (2008) found that students who actively used their personal network (outside their classroom) were more likely to successfully complete their studies.

Learners and teams are interacting in close proximity of each other in and outside the classroom. In line with the importance of cultural proximity, research within the learning sciences has indicated when learners share a similar cultural background and sense of belonging, establishing a constructive and beneficial cooperation among learners is more likely than when learners are from a range of diverse cultural backgrounds (Rienties et al. 2011a). By providing a learning space with specific team assignments that are authentic and build on the knowledge of other teams (Segers et al. 2003; Struyven et al. 2011), whereby learners and teams are expected to learn

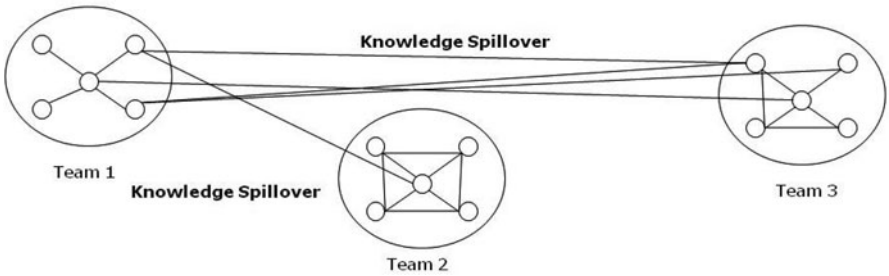

Fig. 11.1 Illustration of knowledge spillovers

from each other's knowledge and experience, share different opinions and viewpoints, the willingness of learners to share information is extended. Therefore, using the metaphor from regional economics, in classroom settings we define *knowledge spillovers* as positive influences that teams receive in terms of knowledge from other teams in the classroom.

Understanding Dynamics of Knowledge Spillovers with SNA

SNA can be considered as a wide-ranging strategy to explore social structures to uncover the existence of social positions of (sub)groups within the network (Katz et al. 2004; Krackhardt and Stern 1988; Rienties et al. 2009). According to Newman (2003), "[a] social network is a set of people or groups of people with some pattern of contacts or interactions between them". In a review of SNA for small groups, Katz et al. (2004) argue that the network perspective can help researchers to identify and explore social network interaction features in groups or networks, e.g. SNA can be used to determine why some learners are more active than other learners (Hurme et al. 2007; Martinez et al. 2003), why some experts receive more inquiries for information than others (Borgatti and Cross 2003) or why some networks develop into successful and sustainable networks while others fail (Bohle Carbonell et al. 2011; De Laat et al. 2007a, b).

In particular, when SNA is combined with other instruments, it provides a powerful instrument to measure dynamic learning processes (De Laat et al. 2007b; Martinez et al. 2003; Rienties et al. 2009), e.g. De Laat et al. (2007b) measured the interaction patterns of two teams at three distinct phases using SNA in combination with content analysis and showed that the dynamics of the teams changed over time. Bohle Carbonell et al. (2011) found that knowledge exchange between team members was influenced by the position in the informal network in a comparison of teams at two different organisations.

In Fig. 11.1, the development of learning interactions within teams and the development of knowledge spillovers between teams are conceptually illustrated. As literature on knowledge spillovers and team learning has found that the degree to

which teams are successfully working and learning together is depending on a range of factors, in Fig. 11.1 this is conceptually illustrated by a varying degree of connections within each of the three teams and a varying degree of knowledge spillovers between teams. Each team consists of five members, who learn and work together on several tasks as is represented by the five actors and their links.

A new element in our research is that teams do not necessarily learn in isolation in a classroom. Even in a team-based classroom, learners may interact or link with their peers outside their team, which might lead to knowledge spillovers from team 1 to team 2 or to team 3. These inter-team relations possibly reinforce the socio-cognitive processes taking place inside each team. So, we argue that the broader learning space in a classroom and the geographical or physical proximity of learners is able to reinforce each team's socio-cognitive factors and is able to create a knowledge-sharing environment that will improve learning. As shown in Fig. 11.1, team 1 has 4 internal team connections, but at the same time has 5 external connections (i.e. knowledge spillovers) to 4 external team members. Team 2 has 8 internal team connections and only 1 knowledge spillover, while team 3 has 7 internal team connections and 4 external knowledge spillovers.

The main goal of the present study is to transfer the insights of knowledge spillovers and external team learning to the classroom. In particular, we want to unravel whether and how knowledge spillovers across teams occurred over time. In other words, in this explorative study that is positioned in an authentic classroom setting specifically designed to enhance inter-team and intra-team learning, we want to explore how researchers may capture knowledge spillovers using SNA tools in order to enhance their understanding of learning exchanges in and outside the classroom.

Method

Setting

This study took place in an elective third-year course of Business Administration in the Economics Faculty at University of Oviedo. The aim of this course was to introduce students to the ideas, concepts, and theories in International Economic Relations (IER). The students met twice a week during 2-hour class session in a 14 weeks period. Fifty-seven students were divided into 11 teams, which consisted of 4–7 members per team who self-selected their members. Except from 7 international students (2 German, 2 Polish, 1 Irish, 1 French), all students were Spanish and coming from the geographical area around Oviedo. The reason for the self-selection of team members rather than random formation of teams was that most students were not familiar with active learning methods such as team work. Research has highlighted when (novice) teams are formed, having a couple of members within a team that are familiar or even friends is beneficial for social interaction (Krackhardt and Stern 1988).

Table 11.1 Teams' interaction opportunities and learning spaces

Interaction	Face-to-face learning space	Online learning space
Intra-team	Teams work on their own materials	Private team forum
	Reading and summarising	Wikis to develop specific written assignments
	Discussing and reflecting	Feedback and corrections through the forum
Inter-team	Presentations of the resulting products each team get from different assignments	Task-specific forum to discuss about tasks and analyse and assess other teams' products
	Discussions	Feedback and corrections through the forum
	Analysis and assessment of other teams' products	

During the 14 weeks, the 11 teams had to solve 5 authentic tasks related to international economics that were highly inter-related. These activities include the creation of a conceptual map of globalisation, writing a comment from an economic blog by a famous economist or organisation and preparing and participating in a final conference about globalisation. The assignments were designed in such a way that they require a broad range of concepts, abilities and skills from teams. In this way, teams and students had to establish a profound understanding of the complex relationships between prior personal and team knowledge and IER concepts. One important thing is that the instructional design offered the teams several opportunities to share knowledge both within and across the teams. Furthermore, intra- and inter-team interaction tools were put into place both in the face-to-face and in the online environment, which is based upon successful designs of a blended learning environment as described in Rienties et al. (2008) and Rehm (2009). Table 11.1 summarises the elements of the instructional design that promote the different types of teams' interactions.

Instruments

Measuring Knowledge Spillovers Using SNA

For ascertaining whether inter- and intra-team learning and knowledge spillovers occurred during the course, we employed a method developed within the field of SNA, i.e. the evolution of knowledge exchange was analysed in three steps. First, learning from team members and other members was measured by using SNA techniques. All the 57 students answered the social network question stem "I have learned a lot from…" in Spanish. A list with all 57 names of the students was provided as is commonly done in SNA (e.g. Bohle Carbonell et al. 2011; Casciaro 1998; Haythornthwaite and Wellman 1998). In class, students had to mark on a Likert response scale of 1 (Totally disagree)–5 (Totally agree) whether they learned a lot from each respective student or not.

Second, the (possible) influence of pre-existing friendship relations was taken into consideration, as the knowledge spillovers between teams may solely be due to friendships rather than genuine learning from other insights and knowledge from other teams (Baldwin et al. 1997; Casciaro 1998; Eggens et al. 2008; Krackhardt and Stern 1988). Therefore, the social network of friendships was measured on the first day of the course using a similar method as the learning network (using the question stem: "I am a friend of. . . "). Afterwards, the friendship network was compared with the social learning network.

Third, in line with De Laat et al. (2007b) and Rienties and Veermans (2012) we measured the social learning network at three phases (week 4, week 7 and week 14) during the course in order to analyse the dynamics of inter- and intra-team learning. For all the three measurements, a 100% response rate was established. Among the 589 learning relationships identified during these three measurements, 74 (2%) were negative (value 1 or 2) by students; 286 (9%) relationships were characterised as neutral (value 3), while 189 (6%) and 589 (19%) relationships were characterised as positive (value 4) or very positive (value 5). As we focus on positive learning relations between students and teams, the valued social network matrixes that resulted from the learning questionnaires were dichotomised by the recoding values 4 and 5 to 1 (indicating that student learned from a respective student), while values 1–3 were recoded as 0 (indicating that a student did not learn from a respective student).

Finally, we determined the position of each student within their team (intra) relative to other students (inter) in the (dichotomised) social learning network using the External–Internal (E–I) index developed by Krackhardt and Stern (1988). Basically, the E–I index takes the number of ties of members of the team to students outside the team, subtracts the number of ties to members with the team and divided by the total number of ties. The resulting index ranges from -1 (all ties are only with own team members) to $+1$ (all ties are to students outside the team).

Critical Event Recall

Critical event recall (CER) is a qualitative method proposed by De Laat and Lally (2004) to provide and gather contextual information from quantitative social network data. As De Laat et al. (2007b, p. 271) argue, CER "enable the articulation of many previously unexpressed aspects of learning and help to contextualise and elucidate individual behaviour, based on personal motives and perceptions in relation to the task and the other participants". In this particular study, as a first step we interviewed the teacher (one of the authors) after the course was finished, whereby she expressed her motives of the course design and her general teacher beliefs and intentions (Anderson et al. 2001; Mishra and Koehler 2005; Rienties et al. 2011a, b). As a second step, we applied CER using the summary results of the three social network graphs as a stimulus for the teacher to critically reflect on her impressions of the dynamics that occurred in her classroom, the discussion forums, WIKIs, presentations and

interactions with the students out-side the classroom. Finally, the teacher reflected on the four teams that differed substantially with respect to the manner in which these teams established the internal and external learning connections as illustrated in Table 11.1.

Data Analysis

We used a methodology of a mixed-method approach to identify how researchers identify that knowledge spillovers occur over time in the classroom. First, a graphical analysis of the learning networks at week 4, week 7 and week 14 was conducted in order to identify the overall social network structure and identify patterns of sub-group development, as recommend by Newman (2003) and Wassermann and Faust (1994). Afterwards, a quantitative analysis was conducted in order to determine the dynamics of knowledge spillovers between teams as well as measuring knowledge spillovers at the three time periods. Finally, a CER technique was used for the teacher in order to reflect on the processes and performance of the four teams (De Laat et al. 2007b). Data were gathered on a team level using UCINET version 6.289. The interrelationships between all measures were assessed through correlation analyses using SPSS 18.0.1.

Results

Development of Learning Networks Using Graphical Analysis

To illustrate the power of SNA in understanding the knowledge spillovers within and between teams, the social networks of learning at week 4 (Fig. 11.2) as well as the social network of learning at week 7 (Fig. 11.3) and week 14 (Fig. 11.4) are presented. Four aspects can be distinguished from these figures. First of all, the social networks illustrate from whom students have learned a lot and what the direction of learning is, e.g. in Fig. 11.2, 1 student of team 3 (diamond) has indicated that he/she learned a lot from 1 student of team 2 (box), which is indicated by the direction of the arrow (Wassermann and Faust 1994).

Second, the respective student from team 2 has 4 so-called "reciprocal links" with the other 4 members of team 2. In other words, all 5 members of team 2 indicated to have learned a lot from each other's contribution and the arrows go to each of the 5 members. However, no reciprocal link is indicated between the student from team 2 and team 3, indicating that knowledge spillovers were primarily from team 2 to team 3. In other words, SNA graphs can be used to determine how knowledge spillovers occur within teams as well as across teams.

Third, the social network graphs show the respective position of individual students as well as of teams. In Fig. 11.2, some learners and teams are on the outer

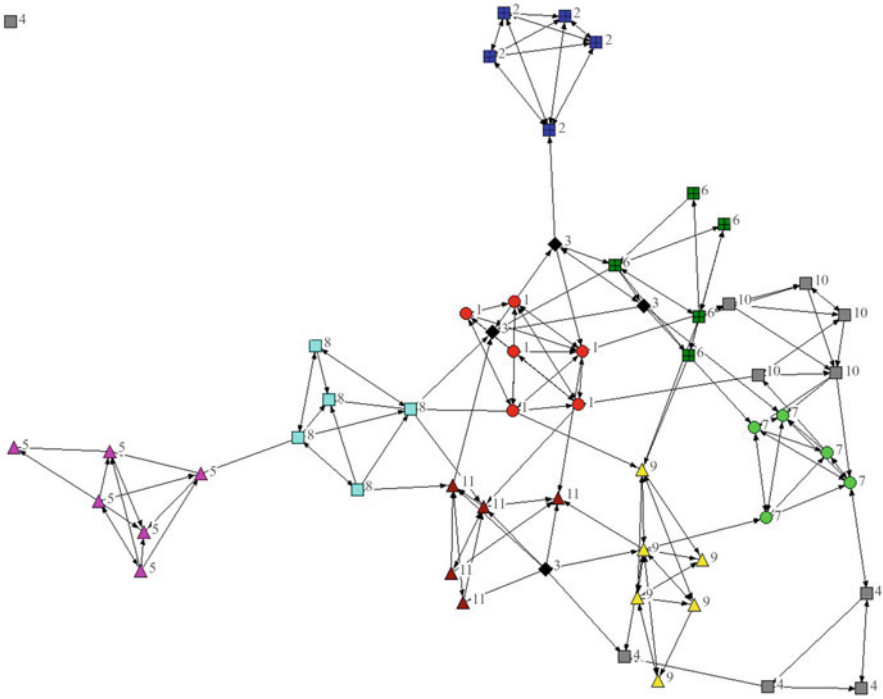

Fig. 11.2 Social learning network after 4 weeks

fringe of the network and are not well-connected to other members or teams, e.g. only 1 member of team 2 and team 5 is connected to a student from another team. As a result, these teams are situated on the outer fringe of the network, while other teams have indicated to have learned more from the other teams. Furthermore, some students and teams are more central in the learning network. Team 3 is an interesting exception to the other teams who are mainly situated closely with their own team members as the members of team 3 are more in contact with other students than with their own team members.

Finally, when comparing Fig. 11.2 with Fig. 11.3, the number of learning links between students and teams alike has increased substantially. More importantly, after 7 weeks the "natural borders" of the teams become blurred as is illustrated in Fig. 11.3, i.e. while in Fig. 11.2 students were primarily interacting within their team, in Fig. 11.3 the position of the members of each team are increasingly mixed and intertwined with other teams. More importantly, the number of connections between learners from different teams is substantially increased. In other words, after 7 weeks members of one team not only indicated to have learned a lot from other members of that team but also from other students. Thus, more knowledge spillovers have occurred across teams after 7 weeks, e.g. team 2 which initially was only connected to 1 member of team 3 is now connected to 8 students from 5 teams; i.e. team 2 is

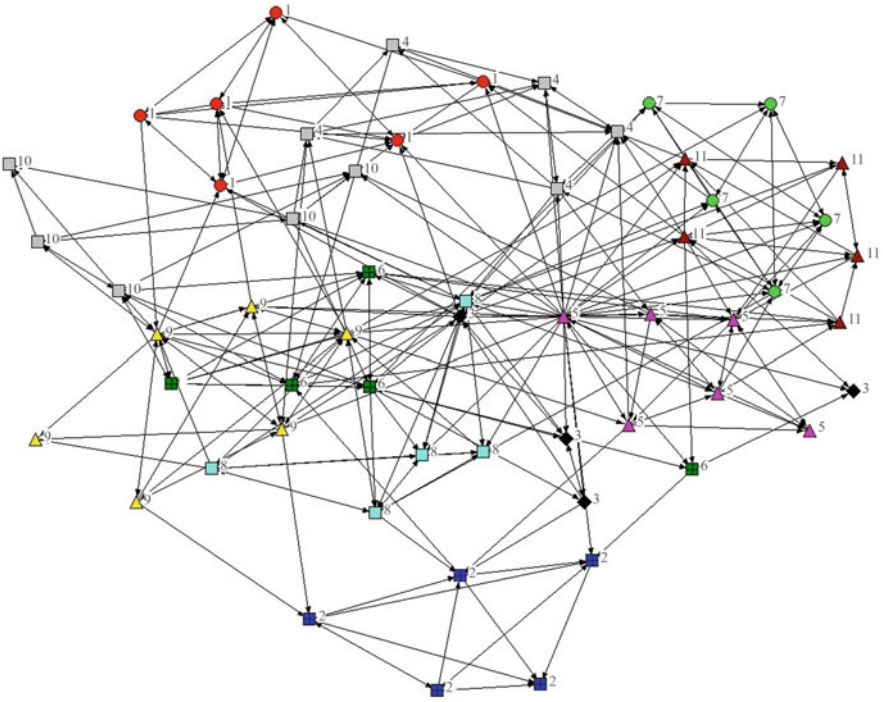

Fig. 11.3 Social learning network after 7 weeks

connected to 2 members of team 9 (triangle), team 6 (square) and team 3 (diamond). At the same time, team 2 is connected to 1 member of team 5 (triangle) and team 8 (square). Furthermore, after 14 weeks team 5 has 17 connections to other students from 9 teams, as is illustrated in Fig. 11.4.

Quantifying Knowledge Spillovers

Although the three social network graphs seem to indicate that teams over time develop more links and knowledge spillovers to other teams, distilling the actual number of intra- and inter-team learning relations per team is difficult to perform based upon visual inspection. Therefore, the E–I index of Krackhardt and Stern (1988) is used to measure the intra- and inter-team learning network relations in Table 11.2. After 4 weeks, all teams except team 3 have more internal links to their team members than to students from other teams. On average, a team has 17.82 (7.0) ties within their team, while 6.5 (4.0) ties are made outside the team after 4 weeks. As a result, the E–I index for most teams is negative and the average E–I index for all 11 teams is −0.53, implying that most learning comes from inside the respective

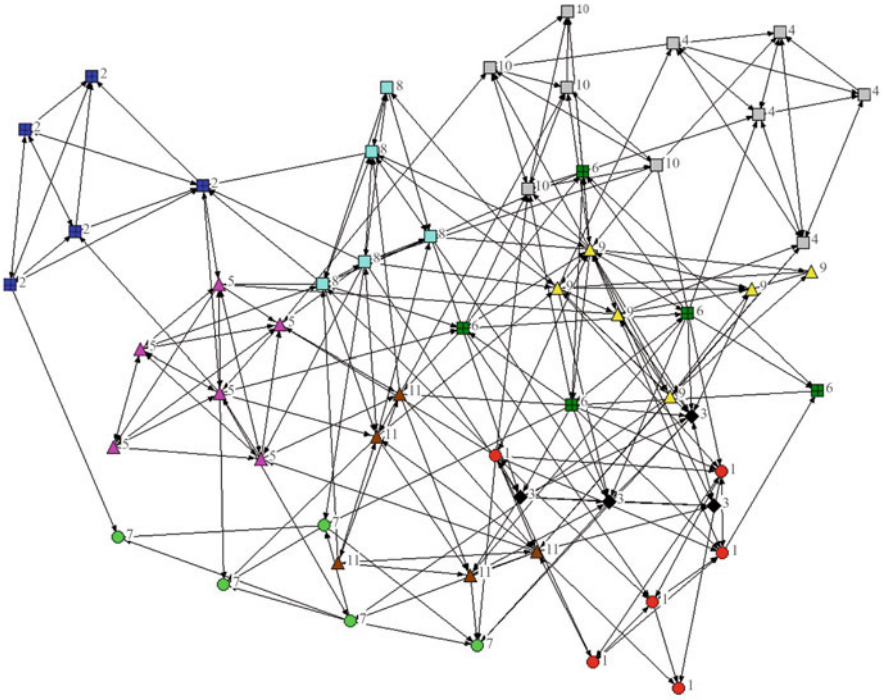

Fig. 11.4 Social learning network after 14 weeks

team. In other words, in the first month of the course students learned most from their team members rather than from students from other teams. This was already visually illustrated by Fig. 11.2, whereby most connections among learners were with other team members. Furthermore, with the exception of team 3 all other teams were visually distinctly positioned and clearly identifiable.

After 7 weeks, the average number of external links triples to 20.0 (9.4), which implies that the number of external links is (almost) equal to the internal links with the teams, and the E–I index is −0.12. In other words, substantial knowledge spillovers have occurred after 7 weeks. In addition to team 3, also team 5, team 6, team 8, team 9 and team 11 have more links to other students than to students within their own team, as is illustrated in Table 11.2. In Fig. 11.3, this was visually illustrated by the fact that most members of team 5, 6, 8 and 9 occupy a central position in the social learning network. Finally, after 14 weeks the average number of external links is 18.4 (7.6) and the E–I index is −0.17, implying that in comparison to the beginning of the course, learning occurs both within teams as well as outside teams. In summary, while at the beginning of the course students were primarily interacting with their own team members, over time substantial learning occurred within and across teams in line with Figs. 11.2–11.4. At the same time, not all teams became externally focussed over time.

Table 11.2 Intra- and inter-team knowledge spillovers after 4, 7 and 14 weeks

Team	Measurement after 4 weeks			Measurement after 7 weeks			Measurement after 14 weeks		
	Internal	External	E-I	Internal	External	E-I	Internal	External	E-I
1	30	7	−0.62	28	13	−0.37	24	16	−0.20
2	20	1	−0.91	20	8	−0.43	20	7	−0.48
3	6	15	0.43	6	20	0.54	12	20	0.25
4	8	3	−0.46	20	14	−0.18	20	8	−0.43
5	24	1	−0.92	30	40	0.14	30	17	−0.28
6	16	7	−0.39	14	29	0.35	18	26	0.18
7	20	8	−0.43	18	13	−0.16	14	12	−0.08
8	18	5	−0.57	20	24	0.09	20	25	0.11
9	24	7	−0.55	24	27	0.06	28	30	0.03
10	16	8	−0.33	16	13	−0.10	18	16	−0.06
11	14	10	−0.17	18	19	0.03	20	25	0.11
Average	17.82	6.55	−0.53	19.45	20.00	−.12	20.36	18.36	−0.17

Knowledge Spillovers, Prior Friendship Relations and International Classroom

In order to control for the fact that knowledge spillovers between teams might have resulted from prior friendships (Baldwin et al. 1997; Casciaro 1998; Eggens et al. 2008; Haythornthwaite and Wellman 1998), we compared the social learning networks at the three time measurements with the social friendship network measured at the beginning of the course. Neither the valued network measure of friendship nor the dichotomised network measure of friendship is significantly correlated to any of the three measurements of learning networks using UCINET QAP correlation (Hanneman and Riddle 2005). Afterwards, the E–I index of Krackhardt and Stern (1988) was used to measure the intra- and inter-team friendship relations. On average, students have 1.3 (1.2) friends within their team and 2.6 (2.2) friends outside their team, whereby standard deviations are in brackets. Using Pearson correlations, there is a significant positive correlation ($r = 0.30$, $p < 0.05$) between internal friendship and learning within a team at week 4, while there is no significant correlation between external friendship and learning outside a team. In other words, students primarily selected friends within their team, but the learning links established outside their own team are not correlated with prior friendship.

Finally, given that 7 international students were mixed with 50 local students from Spain, we verified whether their social networks were comparable. At the first measurement after 4 weeks, international students had significantly more connections to learners outside their own team, as is found in our own research (Rienties et al. 2011a). In particular, international students were on average connected to 3.28 ($SD = 1.50$) other international students outside their own team, while Spanish students were only connected to 0.46 ($SD = 0.58$) international students. This difference remained significant after 7 and 14 weeks, thus indicating that international students

were more likely to connect to other international students. However, the total number of internal and external connections of Spanish and international students were the same after 7 and 14 weeks, indicating that the growth of knowledge spillovers between teams was irrespective of nationality differences.

Critical Review Recall of Team Processes by Teacher

Finally, in order to complete the picture of what has been happening in the learning space and what the behaviour and beliefs of the teams were, a CER (De Laat and Lally 2004; De Laat et al. 2007b) was conducted by the teacher of the course. First of all, the teacher described her teaching style as a mixed model between providing a clear instructional guidance and facilitating discourse and supervision (Anderson et al. 2001; Rienties et al. 2011b). She referred that she clearly established the instructions and guidelines for the tasks teams had to develop at the beginning of the course. Afterwards, when the teams were working on the various assignments, she took a supervising or facilitating role, in line with recommendations of Anderson et al. (2001). Her principal worries in her tutoring role were whether all the members of the group worked and learned effectively together and therefore, she spent considerable effort to detect possible conflicts between the members. Finally, she answered the questions and doubts (very abundant as students were not used to taking their own decisions in relationship with the development of their tasks) but at the same time not trying to give definitive answers that could steer the development of the team's shared vision of the problems.

In order to enhance our understanding, why some teams become more externally focussed, while other teams prefer to learn primarily with their own team members, the teacher was asked to specifically reflect on the two teams with the highest positive aggregate E–I scores with two teams with the highest negative aggregate E–I scores. In other words, she compared the team beliefs of team 3 and team 6, which were primarily inter-team focussed, with team 1 and team 2, which were primarily intra-team focussed.

In relation with the 2 intra-team focused teams 1 and 2, from the beginning she referred that both teams showed a high willingness to work together as a team. In both teams, the members quickly reached agreements on how they were going to develop the tasks and all the members attended class with high regularity. The members of team 1 and 2 had a strong sense of belonging to their team, e.g. they presented themselves with the name of the team when they talked privately with the teacher or when they presented the results of their work to the rest of the class.

The situation of the inter-team focused teams 3 and 6 was very different. From the beginning, both teams were much less structured in dealing with the demands of the various tasks. Both teams had problems to organise themselves and to decide how to develop their work. The attendance to classes was much less regular and the participation in class debates was less efficient. According to the teacher, the teams had difficulties to decide how to share a common view of the tasks. Furthermore,

team 3 and team 6 had members with different grades of commitment to the tasks, which lead to conflicts between members. In the teacher's opinion both teams were not able to develop a sense of belonging to the team and did not believe in the possibilities for the team to successfully complete the tasks. As a result, team 3 and 6 were always asking for ideas or help, not only from the teacher, but also looking for solutions in other class members, as was already illustrated by their position in the social network graphs. Finally, no significant differences were found with respect to exam scores between the 2×2 teams, implying that students had flexible strategies to cope with (in)effective teams.

Discussion

In this chapter, we developed a conceptual model using insights from regional economics and team learning in order to enhance our understanding of knowledge spillovers in a classroom setting. The concept of knowledge spillovers developed in regional economics, i.e. the degree to which knowledge from one team/firm is disseminated to other teams/firms within a certain geographically limited learning space, was used in order to explore whether teams over time develop inter- (i.e. between teams) or intra-team (i.e. within a team) knowledge spillovers.

A first methodological contribution of this chapter is that we combined two streams of research in order to understand the complex dynamics of team learning, whereby we developed a comprehensive understanding of how teams within classroom setting share knowledge spillovers with other teams, i.e. by using SNA of knowledge spillovers in a longitudinal manner, we were able to analyse how knowledge spillovers between teams developed over time both from a visual as well as a quantitative perspective. Using our longitudinal analysis of social learning networks, we found that teams indeed develop more knowledge spillovers with other teams over time, i.e. while in the beginning of the course most teams were primarily focussed on knowledge exchange within their own team (17.8 links internal, 6.5 links external), after 14 weeks the number of knowledge spillovers to other teams almost tripled (20.4 links internal, 18.4 links external).

The more detailed social network graph analyses indicate that teams in the beginning of course were primarily working and learning within their team. As a result, the structures and boundaries of the teams of knowledge spillovers after 4 weeks were clearly defined in the social network graph. However, over time the team structures and boundaries became more mixed or blurred with other teams, which illustrate that teams were actively learning from other teams' knowledge and experience. In other words, the design of the course allowed a learning space for all teams to share knowledge and build a learning environment that transcended the borders of the small working groups. However, substantial differences between teams can be observed.

A second innovative feature of this chapter is that we linked the (quantitative approach) of social learning networks with (qualitative) CER by the teacher. These analyses provide insight in possible factors influencing the dynamics of knowledge

spillovers. The teacher felt that the intra-team focussed teams 1 and 2 were able to establish a mutual shared cognition from the beginning of the course. These teams believed in the effectiveness of the team and as a result were able to build upon the knowledge and experience of each of the team members. In contrast, teams 4 and 6 were not able to establish an effective team spirit, which according to the teacher led to considerable conflicts and stress among the team members. As a result, the team members actively developed learning networks and tried to capitalise on knowledge spillovers with outside members.

In summary, in line with research in regional economics (Capello 1999; Capello and Faggian 2005) and recent team learning literature focussing on external learning (Bresman 2010; Cummings 2004), we found that in our setting a certain number of outside links with other teams are sustained in order to ensure that new knowledge, alternative viewpoints or critical reflection from other teams can be incorporated within the team. Teams who are less successful in establishing an effective learning space within their team are more inclined to search for interaction and knowledge exchange with students outside their team. Even though teams differ in their focus on inter- or intra-team learning, all teams developed a successful strategy to cope with the requirements of working together on team assignments in the course as the results on the final exam and final grade did not differ between the teams. In other words, in our setting, teams who were unable to establish a strong sense of belonging within their own team were able to compensate the lack of co-construction of knowledge within their team by learning from knowledge construction outside their team and got benefit from knowledge spillovers.

Limitations and Future Research

Although this study was developed and designed with the highest care, there are several limitations. The results of this study are based on a mixed-method approach, whereby SNA is used to determine how knowledge spillovers develop within and across teams, which afterwards was used as an input for a CER of the teacher. Although recent research (De Laat et al. 2007b; Rienties et al. 2009) indicates that mixed methods are necessary for creating a profound understanding of the complex dynamics of teams' learning, this can be viewed as a potential limitation to this study in that the (long-term) consequences on learning outcomes have not been demonstrated. Also, the view of the teacher, although important, describes only one "voice", and this should be extended by including the views of the students on the dynamics of the social network. Furthermore, both SNA of learning networks and friendship networks are self-survey instruments, whereby socially desirable behaviour might influence the results. However, socially desirable behaviour in the social learning network was not identified, as no correlations were found between prior friendship and social learning networks after 4 weeks. Finally, the CER by the teacher confirms the findings from SNA scores of the external and internal focussed teams influenced the teams' actual behaviour in class.

Future research should investigate the impact of learner profiles on the behaviours of other learners in their team. By analysing how learners mutually influence each other in collaborative learning, future research should assess how personal traits such as the type of motivation of one learner or the individual's beliefs in team influence the behaviour of others in the teams (Rienties et al. 2009). Furthermore, the socio-cognitive processes through which members of a team collaborate in class do not occur in a vacuum but are influenced by the social context in which they take place (Decuyper et al. 2010; Van den Bossche et al. 2006). The social context affects the learning space: a place where the agents in the learning process—teachers and students—are together; in a collaborative classroom which nourishes their willingness to engage in the (joint) effort to build and maintain mutually shared cognition (Barron 2003). Therefore, future research should address how some teams were able to create mutually shared cognition, while others seem to develop other learning strategies to cope with the demands of the learning environment. Finally, by comparing different pedagogical designs of classroom and active learning teaching (Mishra and Koehler 2005; Rienties et al. 2011b; Struyven et al. 2011) at various different institutes in our future research we hope to provide a more in-depth understanding of how teachers can facilitate and enhance knowledge spillovers between learners and teams.

Implications for Business Education

The results of this study illustrate that social network instruments can enhance a teacher's understanding of the social and cognitive developments within his/her classroom. By implementing a SNA questionnaire after a couple of weeks, a teacher can assess whether all members within a team are actively sharing knowledge within their team and across teams. Students or teams that are not well-connected in the social learning network should be "targeted" in a constructive, yet not directive manner by the teacher in order to determine whether there are any conflicts, miscommunications or personal issues that prevent learners and teams to actively engage in the classroom.

By implementing similar SNA questionnaires on a frequent basis during the course, teachers and researchers alike can improve their understanding of how teams and learners are sharing knowledge and expertise. While in our setting, we implemented a paper-based SNA method that required more data processing before social network patterns could be revealed, currently there are several online questionnaire programs available that allow teachers and researchers to assess the social learning networks of their students and obtain social network data in a comprehensive, time-efficient and straightforward manner. This opens up the opportunity to evaluate the influence of (changes in) the design of the collaborative classroom on the "social infrastructure" underlying learning.

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Part IV
Bridging the Gap

Chapter 12
Opportunities for Technology-Enhanced Remedial Maths

Venkat V. S. S. Sastry and Piers MacLean

Introduction

Many professional development and higher education programmes require learners to have a minimum level of mathematical ability in order to successfully complete the programme. Often these programmes require a similar capability across several disciplines. They are frequently delivered in a full-time mode and the students are expected to achieve a similar capability in physics and chemistry. Any remedial programme in maths, physics or chemistry has to be well thought out taking into account the lack of time for further intervention during intensive courses; once the full-time subject modules commence there are unlikely to be opportunities to formally address further shortfalls in a particular topic area. Where this is the case it can have a detrimental effect on learners' overall performance as they struggle to catch up in the other subject areas. A remedial programme need also take into consideration the heterogeneity that normally exists among cohorts of students. The heterogeneity can manifest itself in two ways, namely prior educational qualifications where the learners are not exposed to the same subject matter at similar levels, and the skills fade caused by both prolonged gaps in education and lack of application of previously acquired knowledge.

This chapter of the book addresses this challenge by describing an approach being taken at the Defence Academy of the United Kingdom in the context of remedial maths during a postgraduate programme for Ammunition Technical Officers (ATOs). The approach consists of implementing two remedial activities: (1) e-assessment generating diagnostic formative feedback and (2) technology-enhanced learning (TEL) support tools to clarify fundamental concepts. Since the remedial programme is

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delivered over a finite number of periods during a 3-week long intensive course covering several subject areas, it is impractical to provide students with comprehensive one-to-one support.

The current practice is to deliver a diagnostic test using Maple T.A. (a web-based test and assessment system) on day 1 to identify the students' abilities, followed by 24 contact hours that include lectures and tutorials where the learners work through a set of exercises followed by a 90 minute written examination. Those students who do not meet the pass criteria, currently 60%, are offered a re-sit examination after an elapsed time of 30 days. During this period, they are offered further tutorial assistance once a week augmented by structured exercises. While students support each other during the tutorial sessions, weaker students tend to prepare for the examination by focusing on developing strategies which do not address the gaps in their knowledge or help them consolidate the essential skills that they need.

In this chapter, we present a detailed process model for combining technology-enhanced interventions together with e-assessment. We also put forward a proposal for evaluating the model formally with a view to informing the selection process and developing appropriate pre-course work packages. The chapter is organised as follows: First, we explore the wider issues of mathematics education in the UK as we establish the context of the chapter and describe the course and students we are working with. The next section provides an account of our current practice with respect to an introductory module and the observations which motivated the proposed intervention. In the third section, we discuss technological issues regarding the tools we have opted to use and the use of feedback with respect to TEL. We then give examples of the learning activities we intend to provide and outline a process model showing how these activities will fit into the existing module. We also comment on some organisational issues and possible obstacles.

Diagnosing the Maths Problem

Over the 5 years during which the data discussed in this chapter were collected, the cohorts of students sampled are likely to have been affected by the 'maths problem' reported by the London Mathematical Society (1995). While recognising that emergent issues and observations in education can be interpreted in different ways, the report found that throughout higher education academics had profound concerns about the preparedness of applicants for courses in mathematics, science and engineering. Moreover, in articulating these concerns it emphasises the economic importance of a sound maths education for all pupils and not just those entering science and engineering courses. It argues that an increasingly diverse range of professional and academic fields require competence in mathematics and the ability to apply the analytical techniques and logical thinking that can be acquired through developing a sound understanding of mathematical concepts, language and thinking.

Although we discuss the importance of maths in context later in this chapter, it must be noted that the report stresses that mathematics should also be seen as

an area of interest in its own right. It recommends that there should not be 'an insistence on all problems being presented "in context"—simple arithmetic questions on fractions should not automatically be translated into problems about dividing pizzas' (London Mathematical Society 1995, p. 8). Part of the reasoning for this comment lies in the need for mathematics to also be seen and valued as an intellectual approach to train the mind and not just a means to an end in problem solving or a set of rules to be applied without deeper understanding of the underpinning concepts. If this is the case, students subsequently will then fail to see that 'the utility of mathematics lies in the fact that if properly understood it can be applied in different, and new, situations' (Croft 2002, p. 148). This point echoes the fierce and on-going debate in the United States about the teaching of mathematics where Stotsky (2009), e.g. sees serious repercussions for higher education and the economy of providing mathematics curricula stripped of intellectual content.

Klein (2007) describes how, in the United States, the intention to correct social inequalities and make mathematics more accessible to minority groups and women saw the elimination of basic skills and dependent intellectual content. The resultant 'maths wars' between mathematicians and progressive educators were reflected in the subsequent political polarisations which were to have the opposite effect to that intended by the progressives. One of the main casualties of these wars has been the use of precisely the kinds of constructivist approaches we will implement in remedial maths tuition, e.g. peer-to-peer learning and other collaborative activities. However, by using such approaches while focusing on improving the basic skills and dependent intellectual content we intend to avoid any sense of trivialising the subject.

To address the 'maths problem', the members of the working group who drafted the report on behalf of the London Mathematical Society, the Institute of Mathematics and its Applications and the Royal Statistical Society, make two main recommendations: (1) setting up a standing committee to overview and advise on mathematics education from primary school through to university and (2) establishing a Committee of Enquiry to examine the then current curricula in mathematics up to A-level.

Anecdotal evidence suggests that individual views about how much progress has been made in addressing the problem till date widely vary at different stages of the curriculum. However, there is evidence to suggest that the situation in higher education has improved greatly and although the changes to the UK A-Level syllabus in 2004 have resulted in greater variance of entry-level qualifications in mathematics (Lee et al. 2008), much more support is available for undergraduate students in maths-based subjects (Bird and Kahn 2009). The universities of Loughborough and Coventry have been at the forefront of developing mathematics support centres. These kinds of centres are now to be found in most UK higher education institutions (Pell and Croft 2008) and come in part as a response to what Hawkes and Savage (2000, p. iii) refer to as the 'increasing inhomogeneity in the mathematical attainments and knowledge of students entering science and engineering degree programmes'. (N.B., This inhomogeneity refers to pre-requisite qualifications in maths and is not to be confused with the broader heterogeneity of educational backgrounds and experience, limited or extensive, of using maths in their practice found among the students we discuss in this chapter.)

More recent additions to the support available are 'mathcentre' (www.mathcentre.ac.uk) which provides downloadable resources such as lesson guides for everyone looking for post-16 maths help and SIGMA (www.sigma-cetl.ac.uk) Centre for Excellence in Mathematics and Statistics Support. These have been developed exclusively within the UK to help in tackling the problem. The latter also includes suggested lesson plans for using GeoGebra in the classroom. Learners in the UK have been able to augment their mathematics studies with support elsewhere via the World Wide Web (WWW) at all levels for over a decade. e.g. the Math Forum which includes the 'Dr Math' service (http://mathforum.org/dr.math/index.html) has been accessible in one form or another since 1992. Originally funded by a series of grants from the US National Science Foundation, the Geometry Forum changed its name and focus to mathematics in 1996. It is currently part of a research project at Drexel University in the United States and remains at the heart of an online collaborative learning community whose interactions 'provide a basis for participant knowledge building about mathematics, pedagogy, and/or technology' (Renninger and Shumar 2002, p. 61). The point here is that from the student perspective, there is no shortage of good materials available on the WWW and elsewhere if they know where to look and are prepared to use them.

In response to the inhomogeneity in entrance qualifications in maths and maths-based subjects, higher education institutions have approached the problem of identifying where and to what level maths support is required among student intakes with increasingly diverse backgrounds. This is often seen in the wide-scale application of diagnostic tests which can be a valuable tool and a beneficial way of supporting student learning:

> Diagnostic testing provides a positive approach to a situation. For the student it provides a constructive method, which leads to ongoing support, and for the academic it is an indication of "what is needed" in terms of teaching and curriculum changes. (LTSN MathsTEAM Project 2003)

As this concluding comment from the LTSN MathsTEAM makes clear, diagnostic testing implies considerable planning and action on the part of the teaching staff. On its own, it is of limited value and 'needs to be accompanied by a programme of support for students whose diagnoses indicate that they need help' (LTSN MathsTEAM Project 2003, p. 3).

While the problem with maths in higher education described here might be the general case, the issue which we will now move on to is more problematical than that found in mainstream higher education institutions. The cohorts we are trying to support comprise of students who are graduates and experienced army officers. Although the course is set at a postgraduate level it is a professional engineering course intended to prepare them for specialist roles. These officers have been selected for the course against a wide range of criteria which do not necessarily emphasise the need for advanced qualifications in mathematics. Moreover, any skills in mathematics they may have learned have often faded over time through lack of use adding to the heterogeneity in knowledge and ability.

The challenge we face is how to take what has been learned about tackling the 'maths problem' found among incoming mathematics, science and engineering

students in general and develop an effective TEL-based remedial mathematics programme for our even more disparately qualified postgraduate-level students. We start in the next section by providing a more detailed picture of the students and the nature of the course in question.

Ammunition Technical Officers

The Royal Logistic Corps (RLC) is one of the largest in the British army. RLC personnel can be found working with and operating alongside all regiments as they manage the flow of resources from start to end. Specialist logistics roles include that of the ATOs who are responsible for managing, maintaining and disposing ammunition. ATOs work includes the design and inspection of ammunition storage sites and the disposal of unexploded ordnance and improvised explosive devices (IEDs). The ATO course is aimed at educating and training selected junior officers up to the rank of captain to become ATOs. It runs in two phases the first of which runs for 22 weeks at the Defence Academy of the United Kingdom—College of Management and Technology (DA-CMT) and is delivered in partnership with Cranfield University. The second phase which is conducted at the Defence EOD Munitions Search School lasts for 9 months. There is 1 cohort per year of not more than 20 students.

Phase 1 of the course is presented in several modules which are designed to progressively develop students' knowledge from the general level to the highly specific. Students are expected to be able to apply this knowledge in all taught subject areas. These subject areas are underpinned by the disciplines of physics and chemistry which in turn require a base level of knowledge and ability in mathematics.

During the 4 weeks of the introductory studies module students are taught the fundamentals of science. What they are taught underpins and supports the remainder of the course. Before progressing with the course students are assessed in general chemistry, thermal physics and waves to ensure they have attained a common basic level in science. The introductory studies include a maths diagnostic test, formal lectures and an assessment which students must pass. During the DA-CMT phase the students sit 14 key exams which, with double and triple weighting on key subject area assessments, equate to 18 exams. They are deemed to have failed the phase overall if they fail to achieve an average of 60% in all modules including maths. If a student fails a module exam they have the opportunity to re-sit the exam at the end of the module using a different paper. Marks obtained in the re-sit are capped at 60%. Current practice with respect to the introductory module maths elements is described in the next section.

Current Practice

The maths revision is delivered up-front in a block of $22 + 2$ contact periods starting with a diagnostic test which is followed by a set of conventional lectures. If they fail the maths exam in week 3, they are offered a re-sit in week 17 which they are expected to pass. The current situation is modelled in Fig. 12.1.

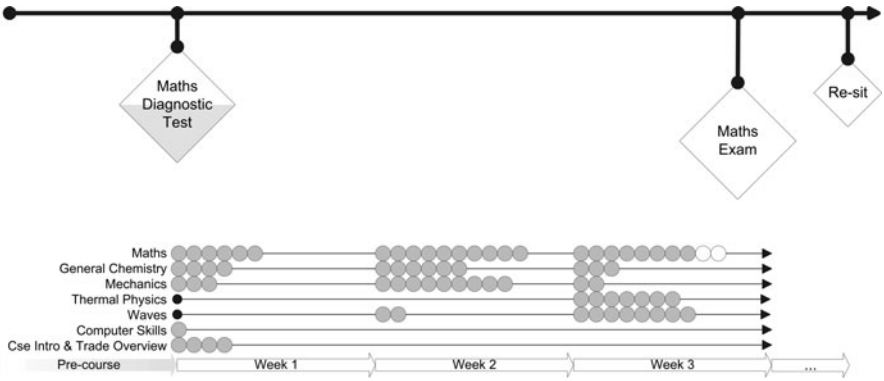

Fig. 12.1 Introductory module maths assessment and total contact periods of 50 minutes for each subject

The diagnostic test is delivered using the Maple T.A. suite of components which, together, form an online system for creating tests and assignments. The suite comprises a web server, content server and transaction router. Users access tests or the authoring environment via a web-browser. At its core is the Maple mathematics engine; a symbolic computation or computer algebra system which is capable of manipulating information in a symbolic or algebraic manner (Heal 2000). Maple's symbolic engine allows teachers to develop question items which take into consideration the combinations of possible correct responses students may make when entering algebraic expressions.

Entering correct mathematical expressions in Maple T.A. is a major challenge for some students, e.g. many do not fully appreciate the difference between $t = (v - u)/a$ and $t = v - u/a$ and the importance of precedence in maths. Consistent errors with precedence and other clearly identifiable types of error are manifestations of what Sleeman (1984) calls *mal-rules* or 'uniform applications of incorrect or inappropriate transformations' (Jurkovic 2001, p. 197). In this case, the application of the mal-rule is partly influenced by calculator usage. Here, in a kind of 'black box' approach (Mayer and Bayman 1981, p. 511), the learner is focused only on a sequence of incorrectly applied key presses and not on how either operators or calculators function. Based on the analysis of paper-and-pencil tests and detailed interviews, Sleeman (1984) proposes a classification of errors encountered in basic algebra which he suggests offers an important practical approach for developing appropriate remedial activities. With respect to our work, remedial activities will largely concentrate on identifying manipulative mal-rules where the student has a notion of the correct rule but fails to apply it, e.g. in precedence they might omit a step or use an inappropriate or incorrect operation. This can occur whether using a calculator, entering an expression in Maple T.A. or working on paper. If we can help students to identify and rectify such errors we will be well on the way to helping them develop a sounder knowledge of maths.

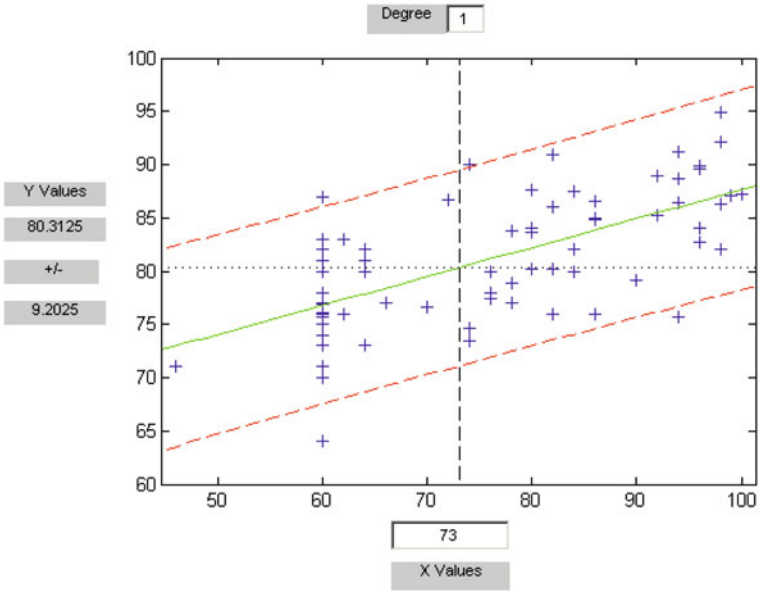

Fig. 12.2 Dependency of performance on mathematical knowledge in final exams Maths scores are shown on the *x*-axis and average scores in other subjects are shown on the *y*-axis

The students' overall performance in the final exams for all subjects is clearly dependent upon their mathematical knowledge. The data set shown in Fig. 12.2 consists of 4 years of cohorts representing a total of 76 students. The graph shows the marks in the assessment for the DA-CMT phase. The concentration of students who obtained 60% in the final maths is an artefact of the data set of student results which only recorded the mark obtained in re-sit exams (capped at 60%) and not the original fail mark. The mark at 45 is a historical artefact where it has been condoned rather than capped. The general trend is clearly visible at 95% confidence levels.

In the upcoming sections, we discuss the potential of certain technologies for supporting maths learning. We then present a description of the intervention we have planned to implement in January 2011 which will make the use of technology with the intention of improving mathematical understanding and performance

Technologies for Learning Maths

Developments in digital technology usage provide learners with new ways to build and apply their mathematical understanding and studies have shown that the use of technology can help learners to conceptualise mathematical problems. Indeed, it has been reported that investigating digital environments can lead to improved high-level reasoning and problem solving (Sacristàn et al. 2010, p. 183). The probability

of learners attaining these levels of understanding is increased if their interactions with the digital environment are provided with timely and accurate feedback (Biggs 2003; Black et al. 2003; Laurillard 2002; Rowntree 1987).

Miller and Upton (2007) report on their work on the design, development and implementation of *mathlets*, small mathematical online learning objects (Lester n. d.). The authors' research into building and deploying dynamic computer applets for use in the teaching and learning of introductory mathematics in higher education provides a useful starting point for others intending to incorporate mathlets in their teaching. Not the least of the main conclusions drawn by Miller and Upton is that the tools helped motivate struggling students. They also report that although they can be used effectively for conceptual learning, such tools are not necessarily universally accepted by students despite their perceived benefits. Mathlets should be aesthetically designed and simple and convenient for students to use. They work best in highly structured activities although, in smaller groups, they are suitable for discovery learning. In terms of designing activities for smaller groups, this latter point brings to the fore the advantages of peer-to-peer discussion made by M. David Merrill:

> Peer discussion promotes opportunities for learners to discuss a given portrayal with one another to determine whether or not it is a good representation of the information; that is, is this example really an example of a kind of x? Does this specific execution of a procedure really involve each of the steps in the statement of the procedure? Does this consequence really follow from the conditions that have been identified for a specific process? (Merrill 2009, p. 47)

Sangwin et al. (2010) indicate that due to significant technical advances and because interactions can be logged by the underlying system, some dynamic computer applets which are used for onscreen manipulations are also suitable for computer aided assessment (CAA or e-assessment). It suffices to say, their description of this kind of free visual manipulation of objects in response to structured assessment questions is a considerable leap forward for e-assessment. However, considerable work is still needed in the UK to develop institutional confidence in the use of advanced e-assessment techniques (Ripley et al. 2009). Current practice appears to rely upon multiple choice and similar items which are mostly constrained to eliciting knowledge of a topic rather than deeper understanding.

GeoGebra

GeoGebra (www.geogebra.org) is an example of an advanced mathlet. It is an open-source interactive geometry software written in Java and as such can run on different platforms or as an applet within a web-browser. Using different views, tools and text-based direct mathematical input within the interface, users are able to construct and manipulate representations of mathematical objects. It has both a dynamic geometry system and a computer algebraic system. While it is not dissimilar from other applications such as Calibri and Autograph, there is no cost associated. Moreover,

there is an active online community of mathematicians creating and sharing GeoGebra resources such as exercises. These aspects make it an attractive choice for initial classroom evaluation. It is our intention to design learning activities which take advantage of these features and engage users in challenging and highly visual activities to consolidate their maths knowledge to solve problems in algebra, geometry and calculus (Sangwin 2007).

We have already stressed that learning activities and assessments work best when timely feedback is provided. This can be done either by the tutor or automatically by the system with which the students are interacting. In addition to allowing for feedback, a key feature of a well-designed learning activity is that it is relevant both to the students' learning and context (Biggs and Tang 2007; Laurillard 2002; Ramsden 2003). It follows, therefore, that learning and assessment tasks should be written in such a way that the student can draw upon more abstract ideas and apply them to a problem which they might encounter in real-life. As Ramsden (2003, p. 65) remarks, deeper approaches to learning are closely linked to the value students place upon tasks. By making maths assessment and learning tasks relevant and intellectually stimulating, students are likely to see how they can be applied within their own context as well as develop the analytical techniques and logical thinking recommended by the London Mathematical Society (1995).

GeoGebra is well-suited to engage the students in group activities to reinforce the basic concepts and also the computer notation of mathematical expressions. An example of a typical exercise, using the GeoGebra in Fig. 12.3, is illustrated below:

> Explore the solutions of the following equations in the interval $[0, 2\pi]$.
> (a) $\sin(x) = 0.25$
> (b) $\sin(2x) = 0.25$
> (c) $\sin(2x + \pi/3) = 0.25$
> (d) $\sin(x/2) = 0.25$
> (e) $\sin(x/2 + \pi/3) = 0.25$.
>
> It is advantageous to show the units on x-axis as multiples of π. Observe the number of solutions of the above equations in the desired intervals. Are the peaks related to the factor 2 in the expression $\sin(2x)$? What are the solutions of the equations $\sin(2x) = 1$?

Figure 12.4 shows an exercise based on an area bounded by curves. Given the task of finding the area bounded by the curves $y = x^2$ and $y = \sqrt{x}$ many students find determining the limits of integration that are obtained by solving the equation $\sqrt{x} = x^2$; squaring both sides they observe $x = x^4$;

$$x^4 - x = x(x^3 - 1) = 0;$$

and immediately jump to the solution $x = 1$, and miss out the other solution $x = 0$ which is needed to identify the lower limit of integration. The aim of the group exercise is to provide additional visual support to discussions about rectifying potential misunderstandings in sketching the graphs correctly or setting up the equations to find the limits of integration or identifying the required area they needed to compute.

In paper-based tutorial sessions, graphing generally takes time and students are reluctant to fully engage with the process of depicting them reasonably well. This is

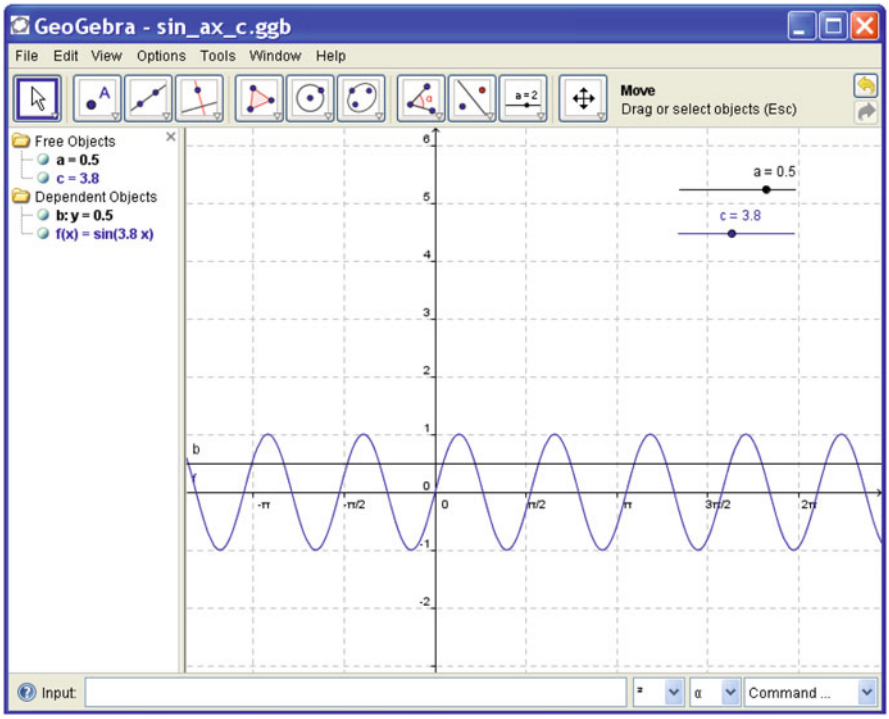

Fig. 12.3 GeoGebra sineplot exercise. Students can explore the exercise problem by manipulating the objects and observing results

where technology can help us to break this barrier by introducing several carefully structured questions that provide rich visual feedback and bring the significance of various parameters to life. See the plot in Fig. 12.4 where the students can discuss the influence of the parameter under question. The graphical approach also reinforces the concept of multiple solutions when solving trigonometrical equations.

Planned Intervention

With effect from January 2011, current practice will be changed by introducing carefully designed interventions. Some of these interventions include additional practice exercises in Maple T.A. to address specific deficiencies in the diagnostic test and group exercises based in a computer laboratory.

If a student is found deficient in manipulating algebraic fractions, she will be provided with additional exercises using the templates shown in column 3 of Table 12.2 shown in the Appendix. These templates will be used to algorithmically generate

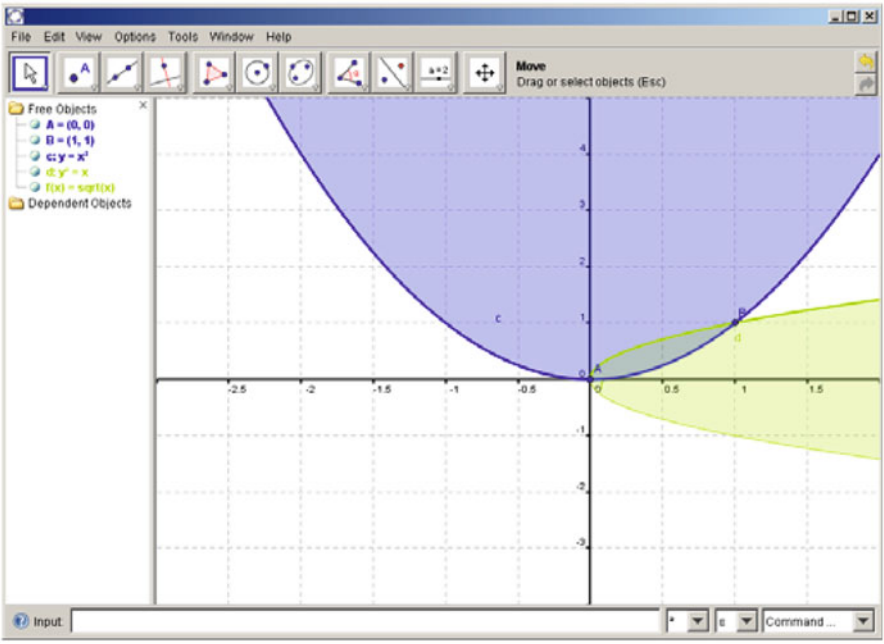

Fig. 12.4 Area under curve for students to explore

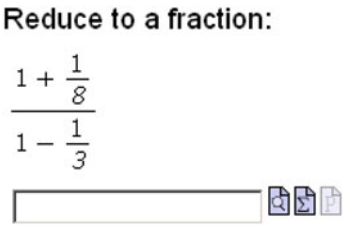

Fig. 12.5 Mixed fractions with assumed denominator 1 consistently causes concern to many students. Students may enter the result in either symbolic mode or simple text entry. The interface allows the students to preview their result before submitting their responses

test items in Maple T.A. The text of an algorithmically generated problem corresponding to the skill set FRAC_NUMERICAL_1 (see Table 12.2) is shown below as it appears in the system view of Maple T.A. How this is rendered visually in a web-browser is shown in Fig. 12.5. Note the text entry box for mathematical input. Students are specifically instructed on how to enter fractional numbers as this issue has been highlighted by previous cohorts as one of their concerns. The students were anticipating finding the division symbol, '÷' on the PC keyboard! The mathematical notation on computing devices is an issue and needs to be managed when designing online assessments.

Table 12.1 All the possible problems generated by the algorithm in Fig. 12.3

No	$f	$g	Answer	Comment	No	$f	$g	Answer	Comment
1	2	2	3		*26*	5	6	36/25	
2	2	3	9/4		*27*	5	7	7/5	*
3	2	4	2	*	*28*	5	8	48/35	
4	2	5	15/8		*29*	6	2	7/3	*
5	2	6	9/5	*	*30*	6	3	7/4	*
6	2	7	7/4	*	*31*	6	4	14/9	*
7	2	8	12/7	*	*32*	6	5	35/24	
8	3	2	8/3		*33*	6	6	7/5	*
9	3	3	2	*	*34*	6	7	49/36	
10	3	4	16/9		*35*	6	8	4/3	*
11	3	5	5/3	*	*36*	7	2	16/7	
12	3	6	8/5	*	*37*	7	3	12/7	*
13	3	7	14/9	*	*38*	7	4	32/21	
14	3	8	32/21		*39*	7	5	10/7	*
15	4	2	5/2	*	*40*	7	6	48/35	
16	4	3	15/8		*41*	7	7	4/3	*
17	4	4	5/3	*	*42*	7	8	64/49	
18	4	5	25/16		*43*	8	2	9/4	*
19	4	6	3/2	*	*44*	8	3	27/16	
20	4	7	35/24	*	*45*	8	4	3/2	*
21	4	8	10/7	*	*46*	8	5	45/32	
22	5	2	12/5		*47*	8	6	27/20	*
23	5	3	9/5	*	*48*	8	7	21/16	*
24	5	4	8/5	*	*49*	8	8	9/7	*
25	5	5	3/2	*					

$$
\begin{array}{lcl}
\$f & = & \text{range}\,(2,8)\,; \\
\$g & = & \text{range}\,(2,8)\,; \\
\text{condition} & : & \text{ne}\,\big(\$f,\$g\big)\,; \\
\$ans & = & \text{maple}\,(\text{“simplify}\,((1+1/(\$f))/(1-1/(\$g)))\text{”});
\end{array}
$$

Enumerations of all problems generated using the algorithm in Fig. 12.3, are shown in Table 12.1. The 'Answer' column in Table 12.1 corresponds to the correct response for the problem using the parameter $f and $g values shown under respective columns. The complete set consists of 49 unique problems. With the constraint $f not equal to $g, the set reduces to 42 problems; also note that 30 of the problems require further cancellation. These problems are indicated by an asterisk in the Comment column. More than 50% of the problems can be considered unfair due to larger magnitude of numerators and/or denominators. While the underlying skill we are trying to ascertain remains the same, large magnitude of numbers appearing in some of the problems, may lead to unduly suspecting one's own skills. This observation is borne out of comments made during informal discussions with the students. It is appropriate to weight the problems accordingly by rewarding more marks. This will require additional programming effort when generating the problems.

The kinds of activities described here using GeoGebra and Maple T.A. will be incorporated within the introductory module maths programme. They will take place

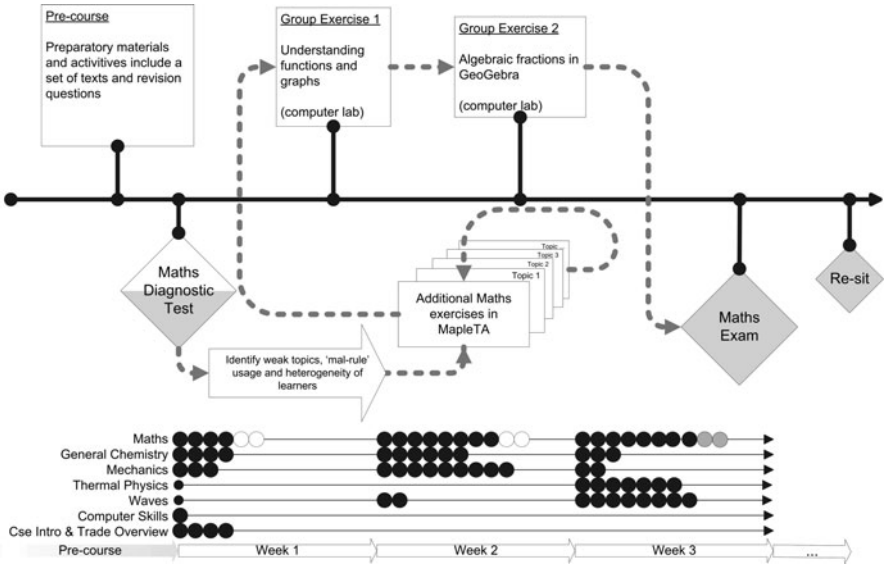

Fig. 12.6 A process model for combining TEL interventions with e-assessment and existing training packages. The number of maths periods in weeks 1 and 2 which will use TEL is indicated by lighter circles

in a student computer room where all the students can access the network, GeoGebra and the Maple T.A. server.

Activities will comprise two periods in Week 1 and two periods in Week 2. In Week 1, they will participate in a computer laboratory group exercise to understand functions and graphs and in Week 2, a second group exercise will use GeoGebra to explain algebraic fractions (see Fig. 12.6).

Analysis of the results from the online Maple T.A. diagnostic test will be used to generate feedback for the students which will guide them through additional, remedial, algorithmically generated exercises in Maple which they can attempt as many times as required. These will be available to them to engage with voluntarily throughout the introductory module. Their weaker areas and remedial training requirements will be matched against the taxonomical structure of the maths knowledge base holding the algorithm templates. At each step, feedback against the taxonomical structure will pinpoint learning paths. Mal-rule usage identified by the online diagnostic test will provide staff with feedback to inform their approaches to the group exercises. The mal-rules themselves will not be explicitly explained to the students to avoid any further misconceptions developing.

The additional maths exercises will be available to the students throughout the 22 weeks of the full course. However, their initial use will support the two computer laboratory group exercises held in Weeks 1 and 2, respectively. The first exercise will develop understanding of functions and graphs and introduce GeoGebra to the students in order to prepare them for fuller engagement with the application in the

second exercise (see Fig. 12.6). During the second exercise the students will be set problems which they will be expected to solve by working together collaboratively.

Where possible, materials will be provided for students to use during the period between selection and joining the course. Data on results and activity participation will be collected and analysed to inform further development of the proposed process model shown in Fig. 12.6.

Further improvements to the use of technology in these and similar interventions will have to take into account the limitations of the organisation which are briefly discussed below.

Feedback and TEL

ATO students will be expected, to a large extent, to be responsible for regulating their own learning through the use of timely and accurate feedback provided by TEL techniques, peers and tutors. We believe that by explaining the expected standards and criteria for assessment to the students and how to use formative feedback (see, e.g. Irons 2008; Nicol and MacFarlane-Dick 2006; O'Donovan et al. 2004) we can help them to make the most of the planned intervention. Nicol and MacFarlane-Dick (2006, p. 9) stress that good quality feedback 'is information that helps students trouble-shoot their own performance and self-correct: that is, it helps students take action to reduce the discrepancy between their intentions and the resulting effects'. In other words, good quality feedback has to be both individual and self-correcting. In addressing the challenges of using technology to auto-generate such feedback we keep in mind their research-based principles for good feedback practice:

1. helps clarify what good performance is (goals, criteria, expected standards);
2. facilitates the development of self-assessment (reflection) in learning;
3. delivers high-quality information to students about their learning;
4. encourages teacher and peer dialogue around learning;
5. encourages positive motivational beliefs and self-esteem;
6. provides opportunities to close the gap between current and desired performance;
7. provides information to teachers that can be used to help shape the teaching.

(Nicol and MacFarlane-Dick 2006, p. 7)

We also bear in mind the findings of Haßler et al. (2004) whose survey of university fresher students into the experience of maths diagnostic testing recommended that detailed evaluation of tests forms the basis for providing sound advice on remedial measures. Using computational methods to do this and provide detailed feedback which gives reliable guidance and supports students' learning will be greatly helped by using the taxonomy of topics (see the Appendix for an example). However, an additional challenge lies in facilitating student understanding of what the taxonomy means and how to make sense of both peer-to-peer and automatically generated feedback based upon the contents of the taxonomy. To do this and to develop a deeper understanding of mathematical concepts they will have to be able to read and communicate, with some fluency, mathematically.

What do we mean by communicating mathematically? Pimm (1987) rejects Wheeler's (1983) assertion that mathematics is not a language and shows how acquiring a natural language of mathematics can support learning. To some extent we agree with these ideas but there comes a point where Wheeler's view is more supportive of our requirements, i.e. the need for a concise and precise verbal expression of mathematical ideas. Encouraging the students to use such mathematical language to express, discuss and think critically about mathematics, which underpins their chosen field, will equip them to function more effectively within it. Attempting to express thoughts about maths problems while using the language of mathematics seems to help with clarifying and organising the thoughts themselves (Pimm 1987) and correctly conveying meaning. A question remains whether, over time, such thinking will result in reduced use of mal-rules and assist learners in asking the kinds of questions which elicit a solution. Quite often, if students can ask accurate questions they are frequently well on the way to being able to answer them for themselves.

Organisational and Other Issues

When introducing technological interventions in new or existing programmes it is inevitable that various obstacles will be encountered. In the case of the proposed interventions in the ATO Course introductory maths module, there are several technological obstacles. The computer equipment and network infrastructure belongs to the Ministry of Defence and as such is controlled by necessarily restrictive policies and procedures. However, we have been able to persuade the local network security authority that GeoGebra applets should be permitted on students' workstations in preference to running them in the browser. This required security accreditation and approval and the cooperation of support staff in the IT Department. Our argument was centred on the benefits which learners would derive from using it in the manner we have described.

Teaching staff will have to be familiarised with the software both functionally and as a teaching tool and students will have to be trained in its use. However, we are confident that thanks to its ease of use, this should not take an unreasonable amount of time. With regard to the use of software and calculators for maths input, we have found that the problems of input 'quirks' identified by Thimbleby (1995) and Mayer and Bayman (1981) continue to have an effect. As a result, there is a considerable amount of work needed to familiarise many students with the various and often 'cumbersome' (Anthony et al. 2005) methods available; if they are struggling with maths in the first instance, their performance is further impeded by the need to understand keyboard text entry and equation editors.

Evaluation

During timetabled remedial maths activities, learners will be asked to provide handwritten descriptive responses explaining the approach they have taken to solve maths

problems. Textual analysis of these responses will be carried out to find the evidence of development in the way in which learners express their thinking improves in terms of clarity, precision and logic. The descriptive responses will enable us to elicit their reasoning behind the proposed solutions. This will be consistent with analyses proposed by Sleeman (1984). It is our observation that those who have understood the principles and avoided the mal-rules are able to express their methodologies using appropriate terminology (cf. Pimm 1987; Wheeler 1983). Their progress in descriptive writing will be compared with performance in the tests. No conclusive results are expected at this stage; however, these will emerge in the controlled experiments planned for the following cohort. Analysis of exam results for each subsequent cohort using GeoGebra will be compared with those of previous cohorts in order to identify the overall effect of the interventions.

Concluding Remarks

Lack of homogeneity in maths qualifications has been identified as a general problem faced by universities offering maths-based courses in a range of disciplines. In the case of our students, this phenomenon is just one facet of the heterogeneous nature of the cohorts we are teaching. Our learners are expected to study physics and chemistry at a post-graduate level yet are not necessarily selected for their mathematical prowess. To remediate the situation for those learners who do not have a strong maths background or who have forgotten much of what they learned we have devised a number of TEL and group learning interventions which allow for feedback given by peers. Pilot Geogebra sessions have demonstrated that its use encourages dialogue among students which can in turn provide an opportunity for contextualised peer support. Extending the range of activities using the dynamic geometry and computer algebraic system found in GeoGebra further enhances peer interaction by way of experimentation. This could not be envisaged in a conventional tutorial session.

This is intended as the first in a number of steps to address deficiencies in maths skills and knowledge and will be evaluated to inform further development. It is our hope that what we learn from the evaluation process will also provide guidance for other departments within the university who face similar issues with their students. Formal evaluation of the model is also carried out with a view to informing the ATO selection process and developing appropriate pre-course work packages. However, there remain, some technological hurdles to be overcome in order to introduce wider use of the model as well as issues around staff training.

The situation we have described and our motivation for designing a TEL intervention is but a first step in a series of developmental activities we are planning for the ATO course with the intention of improving the learning experience for the students and developing their mathematical abilities. By doing so we hope to equip them with a deeper and much clearer understanding of maths and its role not just in their studies but also in their everyday and professional lives.

Appendix

Table 12.2 Abbreviated section of a taxonomy table for maths topics, sub-topics and templates showing fairly indicative (but not exhaustive) examples

Serial	Topic	Sub-topic/skill required	Example/problem template
	Arithmetic	*Numbers*	
ARITH_EVAL_1		Arithmetic precedence, BODMAS	Evaluate 45/5/3
			Sort the numbers $1/(1-\sqrt{2}), e, \pi, \sqrt{3/7}$ in increasing order of magnitude
FRAC_NUMERICAL_1		Fractions	Evaluate $1/[(1/a)+(1/b)+(1/c)]$
	Algebra		
		Factorisation	$x^2-(a+b)x+ab$;
			x^4-a^4;
			$x^3-a^3, \quad a \in \{-3,-2,-1,1,2,3\}$
ALG_FRAC_1	Algebraic fractions	Distinguish $A/(x-2)$ vs $A/x-2$	$A/(x-2)$ *vs* $A/(x-2)$;
			$A/(x-2)$ *vs* $A/(x-2)$ *vs* $A/(x-2)$
		Combine into a single fraction	$A/(x-2)+B(x-1)$
		Terms across equal to sign; re-arrange and simplify	$A/(x-2)=B(x+3)$
		Mixed algebraic-Number plus algebraic	$A+B(x+1)$
		Mixed algebraic-fraction plus algebraic	$A/B+C/(x-1)$
		Mixed algebraic-number plus algebraic with coefficients $A+B/(2x-1)$	$A+B/(2x-1)$
		Mixed algebraic-number plus algebraic; opening brackets in the denominator	$A/B+C[2(x-1)]$
		Monomial plus fraction $x+A/(x+3)$	$x+A(x+3)$
		Divide the fraction into individual terms	$[x^3+(4x-1)]/2x$
FORMULAE_MANIP_1	Transformation of formulae	Adding and subtracting a quantity on both sides;	$c=f\lambda$;
		raising to a power both sides; taking square root on both sides;	$1/R=(1/R_1)+(1/R_2)$
		exponentiate both sides;	$T=T_0e^{-ax}$
		reciprocate both sides;	
		taking logs on both sides	

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Chapter 13
Effectiveness of a Voluntary Postsecondary Remediation Program in Mathematics

Dirk T. Tempelaar, Bart Rienties, Bas Giesbers and Sybrand Schim van der Loeff

Introduction

This contribution focuses on a type of education that is referred to in different ways: bridging education, developmental education, or generally remedial education, directed to ease the transition from high school to university and to improve the success rates in the first year of bachelor studies. In the Netherlands, the main advising council for educational affairs, the Educational Council of the Netherlands, has stressed the importance of bridging education in a range of studies and recommendations (Onderwijsraad 2006, 2007, 2008). The dating of these advices makes evident that Dutch interest in bridging education is recent. Nationwide projects, supported by SURF, the Dutch collaborative organization for innovations in information and communication technology (ICT) in higher education, are functioning since 2004. Some of these Dutch initiatives have acted as pioneers for European projects, indicating that interest in (continental) Europe is also of recent date. EU projects M.A.S.T.E.R. and S.T.E.P. collect experiences with bridging education with a specific European focus of internationalization of European higher education (Rienties et al. 2011). This internationalization development is going fast; for example, for some Dutch

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universities located at short distance of country borders, like the case elaborated in this article, the share of international students in bachelor studies has risen to 75% (mostly from continental Europe). Although most of these students are not very international in terms of the geographical distance they have to bridge, there is certainly a huge diversity with respect to high school education they have received. Secondary school systems, even in neighbouring countries as the Netherlands, Germany, and Belgium, are very different, producing strong heterogeneity in knowledge and skills of prospective students. This heterogeneity brings about a strong need for bridging education in the transfer from secondary to university education, which adds to the more nationally focused needs for bridging education that have existed for some time to bridge knowledge and skill deficiencies in areas that are part of the national secondary school programs, but are not sufficiently mastered by students transferring to university.

The longest tradition of bridging education is to be found in the Anglo-Saxon educational system, and specifically in the United States. Developmental education for underprepared students, as it is generally labelled, in the United States is quite often organized state-wise, and has achieved an enormous reach, such that the estimates of participation of undergraduate students in developmental education in any format offered by community colleges and universities ranges between 40 and 58% of first year students (Attewell et al. 2006; Bailey 2009; Kozeracki 2005). Most recent discussions in the United States on the topic of developmental education is focusing on the question if there is any way back. The opinion that too large a share of public funding of education is finding its way into developmental education is shared by many, opening the debate as how to improve regular education to diminish the need of developmental education (see e.g. the special edition of New Directions for Community Colleges 2008). No surprise, therefore, that by far the most empirical studies into the effect of bridging education refer to the US context: Attewell et al. (2006), Bahr (2008), Bettinger and Long (2004, 2009), Calcagno and Long (2008), Jamelske (2009). For a recent overview about studies that result in very mixed outcomes, see Attewell et al. (2011). Focusing here on the several multi-institutional evaluations of remedial programs that address a broad coverage of college freshmen, Attewell et al. (2006) found no effect for remediation in community colleges, but a negative effect for remediation in four-year colleges, whereas Bettinger and Long (2004, 2009) find positive effects, that are however strongly dependent on the way selection effects are handled. Bahr concludes that:

> . . . students who remediate successfully experience outcomes that effectively are equivalent to those of students who do not require remediation, indicating that remedial math programs are highly effective at resolving skill deficiencies. However, the majority of remedial math students do not remediate successfully, and the outcomes of these students are not favorable. (Bahr 2008, p. 421)

The specific US context of these studies steers to a large extent the way the research question of the impact of bridging education is approached. The US higher education system is strongly based on selection, and part of most selection procedures is that prospective students participate in a placement or entry test and, in the case that they score less than a certain cut-off point, are required to take developmental education. In

such a typical US context, impact studies compare the academic success of students scoring just below the cut-off score (who are obliged to participate in the bridging education) with that of students who score just above the cut-off score (who are excluded from bridging education), using so-called regression-discontinuity models.

In the (continental) European context, such an approach cannot be followed. In most cases, no selection takes place upon entering university education, so the option is missing to obligate some and to exclude other students from bridging education (Brants and Struyven 2009; Rienties et al. 2011; Tempelaar and Rienties 2008). In countries where no selection takes place, as e.g. the Netherlands, the legal basis is lacking to require prospective students to participate in an entry exam, and/or remedial program. Another difference between the United States and the European case is that in the United States placement tests are used to place students at different levels of their first math course—with the lowest level being a remedial course that usually does not earn credits toward a degree—whereas in a typical European case all students are placed in one math course, with remedial education playing the role of bridging toward that single course, again without earning credits. Since most European remedial courses intend to prepare students for a specific, fixed program, or even individual course, that remedial education is mostly organized in classroom settings, with limited use of interactive learning environments, such as computerized, adaptive tutorials (Rienties et al. 2011). The topics covered in such a typical remedial course consist of the fundamentals of the topics taught in the regular course it is preparing for, and are the same for all students participating in the remedial education. Adaptation to the individual level of students is exception rather than rule. In contrast, the placement system within Anglo-Saxon education allows for more individual variation, and thus stronger adaptability, mainly through the use of computerized, adaptive tutorials (Nirmalakhandan 2007).

Although the contexts are rather different, from a methodological point of view, both the European and US contexts share important characteristics. In the investigation of the impact of bridging education, one cannot use the golden research design of an experiment with random assignment, since participation in bridging education does take place on the basis of the outcome of a placement test (United States), or self-selection (Europe), rather than a randomization procedure. A direct comparison of academic success of participants and non-participants of bridging education is therefore not a proper way to find a treatment effect, since the composition of the two groups of prospective students will, in general, be different. The relevant research design is that of the quasi-experiment with non-equivalent groups, that requires a correction of the differences observed between experimental and control group on the basis of differences in background statistics of students in both groups (the covariates). In the US-based empirical studies, it is one single background factor that is the score on the placement test which distinguishes the students in the treatment group from students in the control group, and so allows the use of regression-discontinuity methods. The typical European case lacks such a discontinuity and directs the investigator to methods such as propensity score-based methods (Fraas et al. 2007; Shadish et al. 2002; Yanovitzky et al. 2005) that are recently developed for the quasi-experimental setup without pre-test and with non-equivalent groups. The foundation

of these methods is to correct the treatment effect for differences in background characteristics between treated and non-treated subjects.

The effect analysis presented in this contribution makes use of experiences achieved in the bridging courses in mathematics for prospective bachelor students of the Maastricht University School of Business and Economics. These courses are designed as voluntary summer courses that take place in the summer before the start of the regular bachelor program. In the European context, it is one of the longest lasting cycles of bridging education. Since 2003, these summer courses have been offered without major changes, and in seven consecutive runs, 750 prospective students have participated. The bridging courses focus mainly on international students entering the bachelor study with a non-Dutch prior education, and indeed 90% of the participants are of international background. The propensity score analysis performed in this study benefits from the availability of a unique data set of students' background characteristics, collected in the framework of long-term investigations into first year study success. Data on students' learning approaches, metacognitive abilities, goal orientations, motivational profiles with regard to intrinsic and extrinsic motivation, and subject attitudes based on the expectancy-value framework constitute a broad range of learning-related students' factors that are natural candidates for the correction of selection effects. Against a US background of cumulating evidence that developmental education is expensive—but doubtful in its effects—the central question of this contribution is whether an optional summer course is an effective instrument to help international students bridge math deficiencies caused by differences in national secondary school systems?

Methods

The Adaptive e-Tutorial ALEKS

The characteristics of students entering the programs of business and economics, combined with the outcomes of the entry assessments to be discussed in more detail in the next section, have been conclusive with regard to major design choices of the bridging education, including the preference for a summer school format. Some of the major considerations were:

- The large differences in prior math mastery require a bridging course of considerable size that is up to a workload of approximately 100 hours for students with the most basic forms of prior math schooling. This size is incomparable with that of most of the existing national bridging courses, which are quite often scheduled in a couple of days of intensive teaching.
- For a bridging course of this size and the strong heterogeneity of students, it is crucial that the course is tailor-made: adapting to the students' mastery. Each student should be able to enter the course at the appropriate level.

- To achieve this adaptive feature, (repeated) diagnostic testing is crucial, as well as the ability to adapt learning materials to the outcomes of individual, diagnostic tests.
- The size of the bridging course, and the large variation in workload for students depending on their prior mastery, prevents offering such a bridging course 'in the gate' (that is: intra-curricular, during the first few weeks of the regular program), but forces it to be offered 'before the gate' (that is: extra-curricular, during the summer that precedes the start of the regular program).
- Since participants of the bridging courses are—predominantly—international students, the bridging course cannot be offered on site, but should be offered according to the model of distance e-learning.
- Since the period in which the summer course is offered is also occupied by holidays, jobs, and practical work, the format of the summer course should be very flexible: the summer course should be available over a relatively long period (June, July, August), with maximum freedom for students to schedule their individual learning around other activities in that summer.

Based on all these grounds, it was concluded that face-to face education could not meet several of the above requirements, making the decision to organize the bridging course around an existing adaptive, electronic tutorial inevitable: the ALEKS College Algebra module. The ALEKS system—Assessment and Learning in Knowledge Spaces—is an intelligent tutoring system based on principles of knowledge space theory, a branch of artificial intelligence (Doignon and Falmagne 1999; Falmange et al. 2004). The system combines adaptive, diagnostic testing with an electronic learning and practice tutorial in mathematics and several other domains relevant for higher education. One pillar of ALEKS is the description of such domain by a hierarchic knowledge structure that specifies the interdependencies between the individual items spanning the domain. This knowledge structure indicates which knowledge states are feasible and which are inconsistent. All the feasible knowledge states together constitute the knowledge space. Second pillar of the system is the adaptive assessment engine that in an efficient way provides a probabilistic estimate of the knowledge state of any individual student. Based on that assessment, the system offers material that the student is best able to learn at a given time. In fact, the student can choose from two types of tasks: those belonging to the outer fringe, and those belonging to the inner fringe of the student's knowledge state. The outer fringe consists of new activities, not practiced before, for which the student masters all prerequisite items (new items ready to learn). The inner fringe consists of items the student has practiced before, but for which the mastery level is estimated at less than complete (items suggested for review). The learning report depicted in Fig. 13.1 provides a detailed, graphic representation of the class or an individual student's knowledge state by means of pie-charts divided into slices, each of which corresponds to an area of the module.

In the ALEKS system, the student's progress is shown by the proportion of the slice that is filled in by solid colour. Also, as the mouse is held over a given slice, a

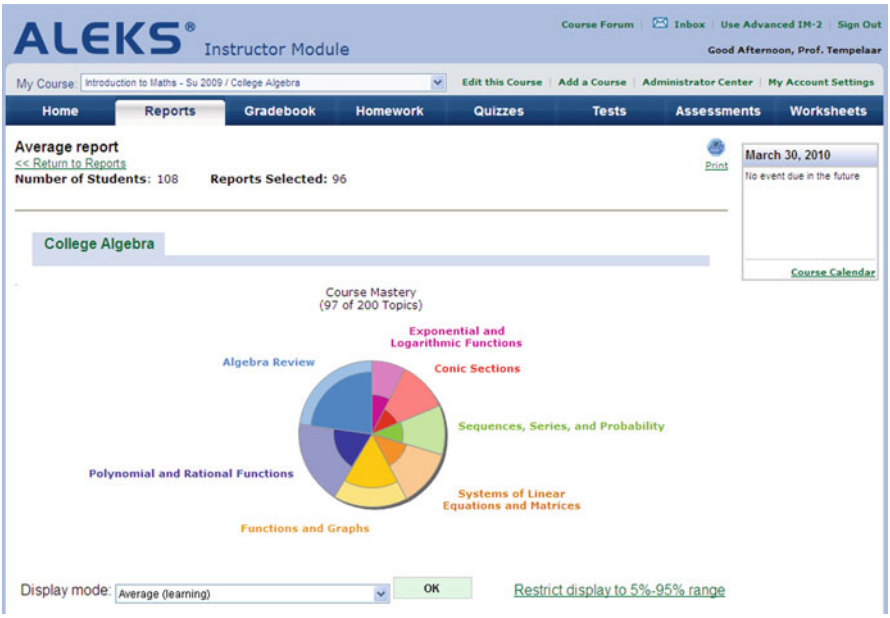

Fig. 13.1 Sample of ALEKS learning report

list is displayed of items within that area that the student is currently 'ready to learn', as determined by the assessment.

Participants and Non-participants

This study is based on the investigation of five of the seven cohorts of first year students in the business and economics programs. In the first two cohorts, we have full information on summer course participation and subsequent academic performances, but lack information on individual difference factors: at that time, these students' background factors were not systematically collected. For that reason, these two cohorts are lost in the application of the propensity score method, since data on predictor variables required to estimate the propensity function are lacking. In total, these five cohorts contain about 4,500 first year students, amongst them 68% international students. Of these students, 578 (13%) decide to participate in the voluntary math summer course. A necessary condition for being accepted in the summer course is an expression of the willingness to invest at least 80 hours of study efforts, a time investment on average required by students with prior math education at basic level to cover the full module. However, that promise appears to be difficult to keep; only 52% of all participants manage to study at least 55% of the topics part of the electronic learning tool, the cut-off level used to determine pass or fail in the summer

course. This required 55% coverage is a mild one, since it includes topics already mastered at the start of the summer course. Students achieving this milestone will be indicated as the successful participants, or the students passing the summer course, the other students being the non-successful or those who failed the summer course. Because of the characteristics of the e-tool, success is strongly dependent on time investment, what is also clear from a comparison of measured time investment: total connect time in the e-tutorial of students passing the summer course is on average 52.1 hours, whereas average connect time of students failing the summer course, that is, not achieving the 55% coverage requirement for passing, is only 15.1 hours. Tool connect time is a conservative estimate of total study efforts such that it measures how much students study within the tool but misses study time outside the tool.

After finishing the summer course, the regular bachelor program starts with two 8-week (half semester) integrated, problem-based learning designed courses, each having a 50% study load. The first course is an introduction into organizational theory and marketing and the other course, called Quantitative Methods I or QM1, is an introduction into mathematics and statistics. The second course is of special interest for this study, since the ultimate aim of the summer course is to optimally prepare students for this QM1 course. The very first activity in the QM1 course is to administer an entry test, for several reasons such as for longitudinally monitoring the math mastery of prospective students, to provide individual students with diagnostic feedback, and to collect data relevant for the design of both the summer course and the QM1 course. The coverage of the QM1 course mirrors the circumstance that strong heterogeneity in math mastery, due to students being educated in different national systems and at different math levels, necessitates a fair amount of repetition. Most topics covered repeat topics educated in the grades 11 and 12 of Dutch secondary schooling, basic math level (the last two years of high school), with some time devoted to new topics. There is no overlap between QM1 and the content of the summer course, since that content is covering topics of grades 7–10 of secondary schooling. Effect analysis in this study will focus on students' achievements in this QM1 course of both participants and non-participants in the summer course. However, outcomes of our study are rather robust with regard to the specific choice of effect variable, due to institutional regulations in Dutch higher education. For example, the presence of a so-called system of binding study advice, forcing students with insufficient academic achievements in their first year to quit the study, makes achieving a pass for QM1 practically a requirement—and in fact the most binding requirement—for achieving a positive binding study advice. Therefore, academic successes in the first year, and that in the QM1 course, do not deviate that much.

The most powerful predictor of academic achievements in QM education is the level of math schooling in high school. In this study, we will distinguish two different levels: basic and advanced. Nearly all European secondary school systems distinguish two levels of pre-university math education; focusing on the three systems most relevant for our study, these levels are A versus B for Dutch secondary education, 'Grundkurs' versus 'Leistungskurs' for the German-speaking high school system, and Math SL versus Math HL for students having an International Baccalaureate

Table 13.1 Composition of five cohorts of first year students with regard to prior education

Summer course participation	Dutch prior education		International prior education		Total
	Math basic	Math advanced	Math basic	Math advanced	
Participant	44 (4.3%)	10 (2.7%)	394 (18.2%)	104 (12.8%)	552
Non-participant	971 (95.7%)	403 (97.3%)	1769 (81.8%)	708 (87.2%)	3,851
Total	1,015	413	2,163	812	4,403

(IB) diploma. The binary variable achieved this way is an important predictor of academic achievement. However, it should be realized that it is no more than a very crude classification, given the strong differences between national educational systems. Table 13.1 contains the decomposition of both participants and non-participants in the math summer course with regard to different types of prior education, and the level of math prior education, of students for whom data on prior education are available. With regard to nationality, two different groups are distinguished: Dutch versus International. Students with an IB diploma are regarded as being part of the last group, but can be of any nationality; this implies that International refers to the type of prior education, rather than nationality.

In agreement with the main goal of the bridging course, the participation is much stronger amongst international students than amongst Dutch students, and much stronger amongst students educated at basic level than amongst students educated at advanced level. Still, there are relatively many summer course participants amongst the international students with advanced math prior education. Main explanation is the tradition in German speaking countries to halt study in between high school and university for one or several years, either forced by military service or voluntary, a tradition that is not present in other continental European countries. Most international students with advanced math prior education who participate have interrupted their study, and they regard the summer course as an opportunity to refresh.

Statistical Analyses

An important focus of this chapter is the methodology of the effect analysis. Since participation in the summer course is on a voluntary basis, a quasi-experimental setup for the effect analysis is required. Besides, the design contains a post-test, but no pre-test, so that it is best characterized as a quasi-experimental design with non-equivalent groups and post-test only (Shadish et al. 2002). Such a design embodies the risk of self-selection. In line with recent recommendations with regard to finding causal effects in observational studies (see the AERA 'think tank white paper', Schneider et al. 2007), a broad range of students' background factors that may be related to potential self-selection effects is included to offset the limitations of a quasi-experimental research design. These students' background characteristics are measured both for students participating in the voluntary summer course and for students who have opted not to participate in the summer course, and originate from long-term longitudinal research into student-related factors explaining

academic success. These background characteristics refer to the type of secondary education (Dutch or international), level of math prior education (basic or advanced), learning approaches, goal orientations, metacognition, academic motivations, and subject-specific achievement motivations.

Traditional approaches for effect analysis in observational studies are based on sub-classification of the participants on key covariates and the inclusion of these sub-classifications in the analysis. Or they determine the treatment effect with a multiple (logistic) regression model or ANCOVA containing as predictor variables, beyond the treatment, also covariates that correct the effect for variation that is not caused by the treatment variable (but is, e.g., the outcome of a selection effect). This approach has its limitations, especially when the number of covariates is large, and when experimental and control group strongly deviate with regard to these background characteristics, creating sparsely populated cells (Fraas et al. 2007; Yanovitzky et al. 2005). Therefore, the preferred methodological approach corrects the treatment effect for non-equivalent group composition (Fraas et al. 2007; Guo and Fraser 2010; Shadish et al. 2002; Yanovitzky et al. 2005). Basis of that correction are the propensity scores: the conditional probabilities that an individual belongs to the experimental group, or to the control group, given a set of covariates (background characteristics). Propensity scores are generally estimated with logistic regression analysis. The correction of the treatment effect can take place in different ways of data balancing: using the propensity scores as matching variables, as stratification variables, or as covariate (Guo and Fraser 2010). The first two methods have in common that they balance subjects in treatment and control groups on the basis of the background characteristics, before making any comparison. If treatment and control group are about equal size, matching is the most straightforward approach of balancing: one pairs every subject in the treatment group with a subject in the control group most similar in propensity score. If treatment and control groups have very unequal sizes, as in our analysis, the matching approach implies the loss of a lot of data: most subjects in the control group cannot be matched with a subject in the treatment group. In such cases, the stratification or sub-classification approach is a good alternative. The data are subdivided in several strata, each having a similar level of the propensity score. Within these strata, shares of treatment and control groups can be very different, but all subjects are very similar with regard to relevant background characteristics, so that the treatment effect can be analysed within each of the strata. Since in our study we have more than seven times as many students in the control group, than in the treatment group, stratification is regarded as more appropriate than matching. A last approach is using the propensity score as covariate. In fact, this is an example of the traditional, ANCOVA-based approach, with the propensity score replacing a set of covariates. We will apply this approach too as an intermediate step to true balancing.

One background characteristic will not be used in determining the propensity scores, but will be included into the model as a separate factor, together with the propensity score: the level of prior math education. This will allow us to make an explicit comparison of the treatment effect of successfully participating in the summer course, with the effect of being educated at advanced math level in high school.

Table 13.2 Domains and scales of the Inventory of Learning Styles

Processing strategies	Regulation strategies	Learning orientations	Learning conceptions, or mental models of learning
Relating and structuring	Self-regulation of learning processes	Personally interested	Construction of knowledge
Critical processing	Self-regulation of learning content	Certificate directed	Intake of knowledge
Memorizing and rehearsing	External regulation of learning processes	Self-test directed	Use of knowledge
Analyzing	External regulation of learning results	Vocation directed	Stimulating education
Concrete processing	Lack of regulation	Ambivalent	Co-operation

The Covariates: Students' Background Characteristics

In finding relevant covariates, we profited from a long-term research project undertaken in our school into study achievements in the first year of study, drop-out, and students' use of alternative instructional modes (Tempelaar et al. 2011). In that research, the role of a broad range of students' background data, all based on self-perception surveys, on academic success or tool use in the first year of study is investigated. The choice of background factors is based on contemporary theories on the role of individual differences in learning, such as Snow's Aptitudes for Learning Approach (Snow et al. 1996; Snow and Jackson 1993). According to this approach, human learning is determined by a wide range of psychological constructs. These constructs distinguish three modes of mental functioning: cognition, conation, and affection, and each of these modes can be subdivided into two underlying sub-domains: temperament and emotion for affection; motivation and volition for conation; and procedural and declarative knowledge for cognition. Self-report instruments were sought over the full range of these modes to assess individual differences; where possible, these instruments were based on European standards for learning research.

The first set of background factors belongs both to the cognitive mode as well to the volition part of conation, and it refers to students' approaches to learning. These are investigated in the context of the learning styles model of Vermunt (Entwistle and Peterson 2004; Vermunt 1996; Vermunt and Vermetten 2004) and the instrument based on that model: ILS or Inventory of Learning Styles. Vermunt distinguishes in his model four domains or components of learning: cognitive processing strategies, metacognitive regulation strategies, learning conceptions or mental models of learning, and learning orientations. In each domain, five different scales describe different aspects of the learning component, as indicated in Table 13.2.

Specific profiles of scores in all domains define typical learning approaches or styles, of which the meaning-directed learning approach and the reproduction-directed learning approach are two important examples. Students learn in a meaning-directed way when they combine deep processing strategies (critical processing, relating and structuring) with self-regulated learning. In contrast, students learn in a reproduction-directed way when they combine stepwise cognitive processing (memorizing and rehearsing, analyzing) with external regulation.

As next background element, students' goal orientations belong to the motivation part of conation. They are measured with an instrument designed by Grant and Dweck (2003), that classifies goal orientations into six types: intrapersonal outcome goals, intrapersonal ability goals, normative outcome goals, normative ability goals, and two different types of learning goals, that differ in the extent the student is longing for challenge: the learning goal (in the strict sense) and the challenge-mastery focused goal orientation. Metacognitive abilities, again from the cognitive mode, are measured by the AILI instrument (Elshout-Mohr et al. 2001; Tempelaar 2006). The instrument is based on Flavells' three component model of metacognition, which decomposes metacognition into the components' knowledge, skills, and attitudes. Another exponent of the motivation part of the conation mode is the Academic Motivation Scale (AMS; Guya et al. 2003; Ratelle et al. 2007; Vallerand et al. 1993). It is based upon Ryan and Deci's (2000) model of intrinsic and extrinsic motivation, and generates motivational profiles of students containing different types of intrinsic, extrinsic, and a-motivation. Last, subject attitudes based on Eccles' expectancy-value theory (Eccles and Wigfield 2002) are measured with an instrument derived from the Survey of Attitudes Toward Statistics (SATS) developed by Schau and co-authors (Schau et al. 1995; Tempelaar et al. 2007). In the Snow model, learning attitudes are at the border between the affective and conative modes. The SATS instrument measures six aspects of students' subject attitudes, amongst which two expectancy factors that deal with students' beliefs about their own ability and perceived task difficulty: Cognitive Competence and Difficulty, and three subjective task-value constructs that encompass students' feelings toward and attitudes about the value of the subject: Affect, Interest and Value. The sixth aspect, Effort, is assumed to be the outcome of the process of weighing expectancy against value.

All instruments together comprise 42 different scales measured by more than 250 items. Given the size of this data set, we will refrain from providing descriptive statistics and instead refer to Tempelaar et al. (2011) for more details. Statistics are, however, in the expected range with, for example, reliabilities ranging from satisfactory to good (0.6–0.9), the large majority falling in the interval 0.7–0.8. Reliabilities of scores in the final QM exams, used in our study as the effect variable, are high, and typically range between 0.8 and 0.9. These exams are strongly based on international standards such as provided by the Advanced Placement Statistics and Calculus programs. A last instrument used, primarily to motivate design choices in the summer course program, is a national entry test in mathematics.

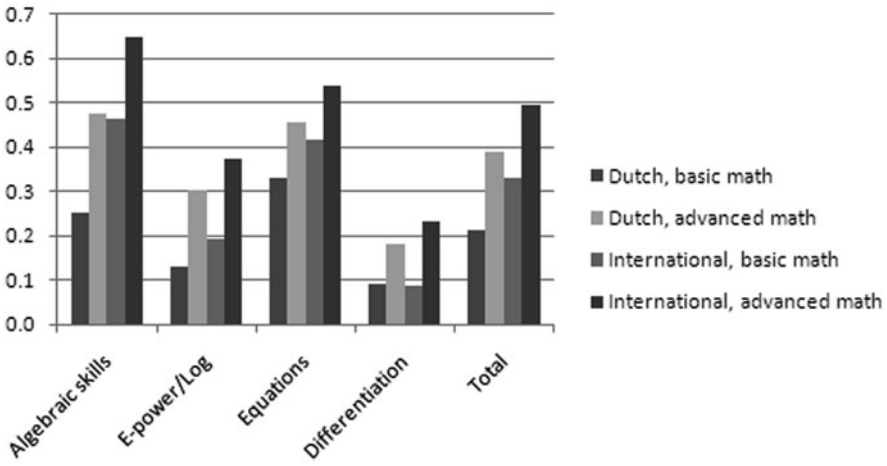

Fig. 13.2 Proportion correct scores of the entry test and its topics, broken down along prior education

Results

The National Entry Test

In the framework of several, consecutive projects in the Netherlands to improve transition from high school to university and to monitor math mastery levels, national entry tests for mathematics have been constructed. In the present study, these entry tests serve the limited role of providing a justification to design our summer course around basic algebraic skills taught in middle school, rather than more advanced mathematical skills typically taught in high school. Although the entry test scores along with the final test scores could have been used in the effect determination, we chose not to do so, since the entry test was announced to be a crucial tool for students to bring forward any specific additional topics, making it a less valid instrument of students' math mastery.

In three out of five cohorts in this study, the same version of the national entry test is administered, implying more than 2,600 test takes of that test. The short test consists of four categories of math competency, all being part of middle school or early high school coverage of math topics. The two most elementary topics are algebraic skills and e-powers and logarithms, with the other two topics, equations and differentiation, being slightly more advanced. Figure 13.2 contains the scores for each of those four topics, and the total score, for four different categories of students: students educated in the Dutch secondary school system or not, crossed with students educated at advanced level, versus basic level, with regard to their math prior education. Scores in the figure are p-values or proportion of correct answers, after correction for guessing (since the entry test contains multiple choice items).

Scores in the entry test are (disappointingly) low. Some low scores have been expected because it was known that more advanced topics as solving equations and differentiation, although being taught in programs for basic math all over Europe, are not fully mastered by prospective students, and are in need of repetition within the regular program of first year university education. Important outcome of the entry test, however, is that the crucial math deficiencies exist beyond these advanced topics. Also topics like algebraic skills and e-powers and logarithms, being firmly rooted in any middle school program, produce no better outcomes than very incomplete mastery. Traditionally, these basic topics are no part of regular university teaching, implying that any deficiency will stay if not addressed in a bridging course.

Another crucial observation from the entry test scores is that whereas the bridging courses have been primarily designed for international students being educated in school systems deviating from the typical Dutch program, deficiencies of Dutch prospective students seem to be larger than those of the international students. However, one should be cautious in the interpretation of differences in group means, since selection effects are highly probable. Still, relative to the total score, it is surprising to see how meagre is the score of students with a Dutch prior education, especially in algebraic skills. In fact, with regard to this topic, Dutch students educated at the advanced level do not perform better than international students educated at the basic level. A finding that justifies the large scale of national projects in math bridging education within the Netherlands: beyond reasons of internationalization, there are urgent reasons related to the national state of affairs of math mastery for providing remedial education.

Descriptive Analyses

Non-corrected treatment effects of successful participation in the summer course of students being educated at basic math level versus advanced math level for the total score in the course, QM1 total score (with a maximum score of 40), are exhibited in Fig. 13.3; for the QM1 passing rate, in Fig. 13.4. The effect of prior education at advanced level, compared to basic level, is 4.6 points in the QM1 total score (or expressed as effect size, 0.64 standard deviations), against 23% in the passing rate (0.53 standard deviations). The effect of successful participation in the summer course, with no participation as reference, equals 5.3 points in total score (0.76 standard deviations), respectively 28% in passing rate (0.56 standard deviations) for students educated at the basic level, and 3.8 points (0.54 standard deviations), respectively 13% (0.31 standard deviations) for students educated at the advanced level. As expected, the treatment effect is much larger for students educated at the basic math level than for students educated at the advanced math level. For the principal target group of students in the summer course, those with a basic math prior education, the non-corrected effect of successful participation in the summer course is even that large, that they outperform students with an advanced prior math

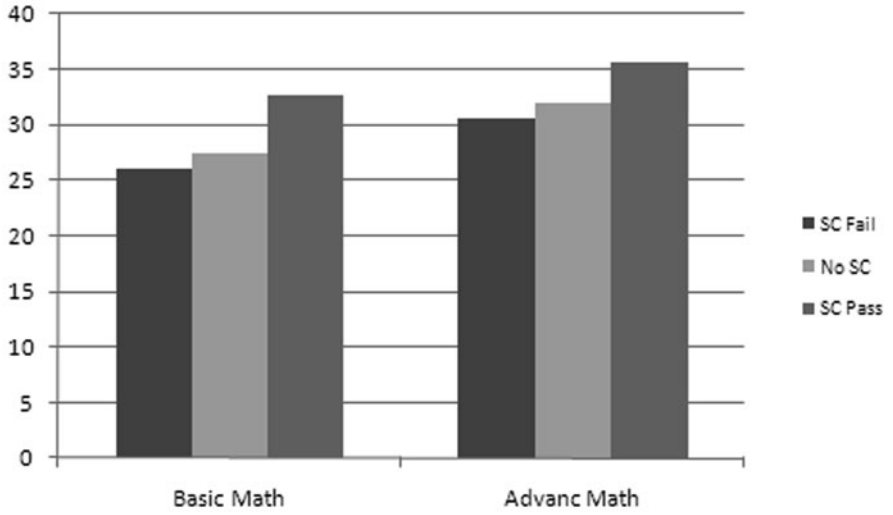

Fig. 13.3 Non-corrected treatment effect of successful participation in summer course on QM1 total score

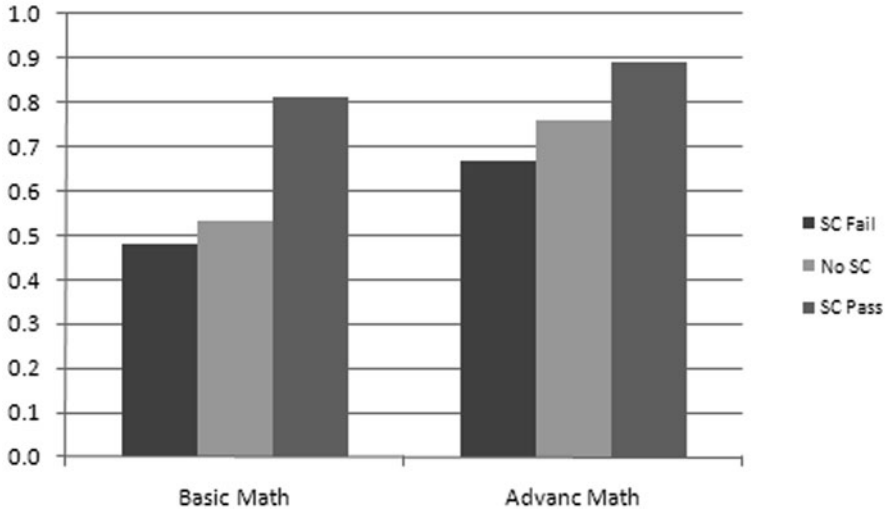

Fig. 13.4 Non-corrected treatment effect of successful participation in summer course on QM1 passing rate

education who do not participate in the summer course, both with regard to QM1 total score and with regard to QM1 passing rate.

As part of our study, we investigated the existence of any cohort effect, that is, any effect of the remediation being dependent on the specific cohort in which the students are in. There are differences between cohorts with regard to the participation

rate in the summer classes, mainly due to trying out some different formats of public relations, some appearing to be more successful than others. However, no cohort effects were found with regard to summer course achievements, background characteristics, or course performance, and for that reason, no cohort-specific outcomes are reported here. See also Tempelaar and Rienties (2008), reporting on a subset of three of the five cohorts.

Propensity Scores

In the propensity score analysis, we followed the six-step approach proposed by Yanovitzky et al. (2005); see also Fraas et al. (2007). The first step comprises the selection of the covariates, or in the terminology used by Yanovitzky et al. (2005), the confounder pool. As such, we applied our existing data set of self-perception surveys used in our research directed at explaining study success. Since in the correction for non-equivalent groups we are especially keen to offset any selection effect that may influence academic success, this data set constitutes an adequate confounder pool. In addition, it satisfies the requirements of step 1: the set of covariates to be used should be based on theoretical grounds and previous empirical research, and not on patterns of association with the actual data in the experiment.

The second step assesses the initial imbalance in the covariates between the groups using independent samples *t*-tests. The assessment can have two different outcomes. If the balance is adequate, that is, if differences in background characteristics between the two groups are no larger than one would expect for a randomized experiment, there is lack of evidence of a selection effect based on the chosen covariates. In that situation, there is no need to apply the propensity score method, and group means can be directly analysed. The alternative outcome is one that signals imbalance: more *t*-tests for differences in means appear to be significant than to be expected given the significance level of the tests. Apparently, this is the case where selection takes place on the basis of the chosen set of covariates, and the propensity score method provides an adequate approach to analyze the effect. In this situation, the outcomes of the *t*-tests serve as a benchmark to judge if the propensity score method achieves its goal of creating increased balance in the covariates. In our study out of the 42 learning-related scales in our data set, 30 demonstrate statistically significant differences in means when contrasting summer course participants with non-participants, always in the direction that participants in the summer course achieve on average more favorable scores than non-participants. Only 12 scales do not demonstrate significant differences, amongst them the two scales of the deep learning approach (relating and structuring, critical processing), the two scales of extrinsic motivation, and the attitude of valuing quantitative methods. This outcome signals substantial imbalance to be addressed by the propensity score method.

The third step entails the estimation of the propensity scores or the conditional probabilities to be member of the experimental group, given the scores on the covariates. These propensity scores can in principle be estimated using a variety of

methods, as discriminant analysis, probit models, or logistic regression with the dependent variable being the group variable (e.g., experimental and control), and the covariates serving as the independent variables. The use of logistic regression appears to be the most common method (Yanovitzky et al. 2005), and is therefore preferred as estimation method in our study. Logistic regression methods are available in most statistical software packages, such as SPSS, which we used in our study. Since the estimation of propensity scores requires full data availability of not only data on math summer course participation and subsequent academic performances, but also full availability of data on all background characteristics, the relevant data set that can be used for propensity score estimation shrinks to 3,240 students with complete data records. With regard to the outcomes of the logistic regression analysis determining the propensity scores: most of the learning characteristics used as covariates are correlated, causing collinearity, so it is no surprise that only 6 of the 42 students' background characteristics appear to be a statistically significant predictor of summer course participation (beyond prior math education). By far the strongest predictor is, in agreement with the design aims of the summer course, the indicator variable distinguishing international students from students with a Dutch prior education. Next, in the order of decreasing impact, are the vocational learning orientation, self-perception of cognitive competence (negative), metacognitive knowledge, the constructivist learning conception, and a-motivation (negative). The outcomes of the logistic regression, both in terms of statistical significance of predictors and the sign of the regression coefficients, are intuitive: international background, the conception that learning takes place through self-construction of knowledge, and good metacognitive skills strengthen the probability to participate in the summer course, whereas lack of learning motivation, and one's perception to be already rather competent in the area of quantitative methods, weaken the probability of participation. In agreement with procedures advised in the literature (Fraas et al. 2007; Shadish et al. 2002; Yanovitzky et al. 2005), propensity scores are estimated on the basis of the full model, that is all covariates included, both those being statistically significant and those being nonsignificant.

The remaining steps of the six-step procedure will be described in more detail in later sections. They include at first step 4: stratify the propensity scores or probabilities to be in the experimental group (logistic regression has as dependent variable a quantitative variable in the 0 to 1 range) into four or five levels with equal or nearly equal number of subjects (using more than five groups generally adds little gain, see Fraas et al. 2007; Shadish et al. 2002; Yanovitzky et al. 2005). Next, in step 5 the balance of the covariates across the two groups is once more assessed, this time for each of the strata separately. This step verifies that grouping on propensity score indeed removes, or strongly decreases, the initial bias on the covariates. That is the separate strata are more balanced than the complete data set. If balance is achieved, in step 6 one estimates and statistically tests the difference between treatment and control group means, using again independent samples *t*-tests, and the overall treatment effect calculated by averaging the differences between means of the two groups across all strata (propensity score groups).

Table 13.3 Outcomes of effect analysis of summer course participation on QM1 total score with propensity score as covariate

	Beta	*t*-value	significance
Propensity score	0.072	4.116	0.000
Advanced math dummy	0.271	15.978	0.000
Successful participation summer course dummy	0.154	8.899	0.000
Non-successful participation summer course dummy	− 0.086	− 5.002	0.000

Propensity Score as Covariate

After the estimation of propensity scores, the effect analysis is repeated, with the propensity score added as extra predictor, next to the indicator variable of math prior education and the treatment variable of summer course participation. Depending upon the choice of the effect variable, QM1 total score versus QM1 passing rate, the proper method for doing effect analysis is that of multiple regression, respectively, binary logistic regression. Table 13.3 contains the outcomes of multiple regression of QM1 total score on the predictor variables propensity score and three indicator variables (dummies) which are math prior education at advanced level, successful participation in the summer course, and non-successful participation in the summer course (this choice of indicator variables implies that math prior education at basic level, and no participation in the summer course, serve as reference groups). Propensity scores and the three indicator variables together explain 11.2% of the variation in total score.

Table 13.3 confirms the picture sketched in the last results section: participants of the summer course stand out from non-participants in terms of background characteristics that have a positive impact on learning. The consequence of this is that in the corrected calculation of the effect of summer course participation, a part of explanation of academic success by successful summer course participation is absorbed by the propensity score, as compared to the non-corrected model. The obvious implication of this is that the contribution to explained variation by summer course participation becomes smaller, and the variable is no longer the strongest predictor; the indicator variable distinguishing math prior education at advanced level takes over that position. However, a substantial effect of successful participation in the summer course remains: the beta (standardized regression coefficient) exceeds 50% of the value of the beta of the predictor variable math at advanced level.

Shifting the focus to passing or failing the QM1 course as outcome variable, a similar picture emerges. The proper method is now that of binary logistic regression; Table 13.4 contains the outcomes of such a regression. The explained variation, expressed as the Nagelkerke R^2, equals 8.1%.

For the interpretation of the outcomes of the logistic regression, it is especially the last column of Table 13.4, which provides the changes in the odds of passing the QM1 course as the result of a unit change in the predictor variables, which deserves attention. Students' background characteristics that influence the participation in

Table 13.4 Outcomes of effect analysis of summer course participation on QM1 passing rate with propensity score as covariate

	B (SE)	Significance	Exp (B)
Propensity score	1.298 (0.456)	0.004	3.663
Advanced math dummy	0.967 (0.091)	0.000	2.629
Successful participation summer course dummy	1.097 (0.181)	0.000	2.996
Non-successful participation summer course dummy	− 0.494 (0.149)	0.001	0.610

the summer course are the strongest determinant of the odds to pass QM1: see the coefficient of the propensity score. Next are the two indicator variables for math at advanced level in prior education and successful participation in the summer course, with the notable detail that predictive power of the summer course participation dummy exceeds that of the advanced math dummy.

Propensity Score as Stratification Variable

The best protection against the impact of potential selection effects in a quasi-experimental research design with non-equivalent groups is offered by balancing, in our case through quintile stratification of all subjects on the basis of the propensity scores as stratification variable (Fraas et al. 2007; Guo and Fraser 2010; Shadish et al. 2002; Yanovitzky et al. 2005). This literature suggests the creation of five strata, based on the quintiles of the distribution of the propensity scores. Each of these five strata this way contains subjects with propensity scores of the same magnitude, so that within a stratum, treatment and control groups are approximately equivalent. This way, effect analysis within each stratum is minimally influenced by differences between subjects in their value on the propensity score, providing a correction for the selection effects that depend on background characteristics used in the estimation of the propensity scores. We applied this approach, and repeated the multiple regression analysis described in the last section for each of the five strata created by distinguishing the five quintiles of the propensity score. The outcomes of these regression analyses are collected in Table 13.5.

In order to fulfil the fifth step of the six-step approach introduced before, the stratification appears to achieve exactly what it is intended for, that is, the influence of students' background characteristics, expressed as propensity score, is statistically insignificant in all five strata, where it had been the strongest predictor before stratification taking place. Since treatment and control group overlap in all five strata, we can do an even more thorough check of the adequacy of the propensity score-based stratification by performing difference in means tests between the groups of participants and non-participants of the summer course, for all 42 predictor variables in all five strata (Guo and Fraser 2010). Performing these test at a 5% significance level, we find 3, 2, 1, 0, 1 significant differences in strata 1–5, respectively, so 1.4 on average in each stratum. This compares quite well to the expected 2.1 significant differences one expects when testing at 5% level. As a reminder, in the complete data set we

Table 13.5 Outcomes of effect analysis of summer course participation on QM1 total score with propensity score as stratification variable

	Beta	*t*-value	significance
Stratum 1: propensity score < 0.055			
Propensity score	0.062	1.715	0.087
Advanced math dummy	0.365	10.065	0.000
Successful participation summer course dummy	0.061	1.674	0.095
Non-successful participation summer course dummy	− 0.118	− 3.251	0.001
Stratum 2: 0.055 < propensity score < 0.117			
Propensity score	0.022	0.563	0.573
Advanced math dummy	0.310	8.124	0.000
Successful participation summer course dummy	0.173	4.511	0.000
Non-successful participation summer course dummy	− 0.050	− 1.308	0.191
Stratum 3: 0.117 < propensity score < 0.166			
Propensity score	0.008	0.201	0.841
Advanced math dummy	0.222	5.697	0.000
Successful participation summer course dummy	0.127	3.257	0.001
Non-successful participation summer course dummy	− 0.090	− 2.315	0.021
Stratum 4: 0.166 < propensity score < 0.217			
Propensity score	0.041	1.063	0.288
Advanced math dummy	0.195	4.990	0.000
Successful participation summer course dummy	0.146	3.735	0.000
Non-successful participation summer course dummy	− 0.117	− 2.996	0.003
Stratum 5: 0.217 < propensity score			
Propensity score	0.007	0.191	0.849
Advanced math dummy	0.268	7.071	0.000
Successful participation summer course dummy	0.210	5.485	0.000
Non-successful participation summer course dummy	− 0.068	− 1.769	0.077

found 30 out of 42 differences to be significant, indicating that stratification indeed succeeds in taking away any selection effect induced by these 42 predictors. In conclusion, quintile stratification does provide a sub-classification in which treatment and control groups are equivalent with regard to all covariates under study.

Stratum-specific regression outcomes appear to be quite similar to the outcomes achieved on the complete data set, with the first stratum producing slightly deviant outcomes. In that first stratum, the quintile of students with the lowest score for students' background characteristics that contribute to participation in the summer course, the positive effect of successful participation in the summer course is outshined by the negative effect of failing the summer course. This different position of the first stratum is an artefact of the way the strata are created. Due to the very low propensity scores of students in this first stratum, that stratum counts by far the fewest number of participants of the summer course, and amongst those participants, the large majority drops out of the summer course (amongst the 660 students in this stratum, there are only 23 participants in the summer course, of which 17 drop out). The other four strata, each containing many more summer course participants and especially many more successful participants, all demonstrate the same pattern as found in the full data set. The largest effect is that of the indicator variable of prior

math education at advanced level, with the treatment effect of successful participation in the summer course in the second position, having an effect size of at least 50% of the effect size of advanced math.

As the sixth and last step in the six-step approach, we aggregate stratum-specific effect to achieve an overall measure of effect. Such an overall measure of the treatment effect is provided by the average treatment effect (ATE; Guo and Fraser 2010), calculated by averaging the stratum-specific differences of the mean QM1 scores between treatment and control groups. The ATE equals $t = 4.75$, which is clearly significant at 5% or 1% levels. Focusing on the four strata with a substantial amount of summer course participants, that is excluding the first stratum from the calculation of the ATE given the very small number of participants, the statistical significance even achieves the size of $t = 11.27$.

Redoing the logistic regression analysis to determine the treatment effect of participation in the summer course on the passing rate of the QM1 course after stratifying the data set into five strata based on the quintiles of the distribution of the propensity scores, we achieve equivalent outcomes. Within each of the strata, the propensity score has no statistically significant effect anymore on passing rate, and except for the first quintile, where success in the summer course appears to be insignificant for the QM1 passing rate, the other four strata demonstrate significant effects of both math prior education at advanced level and successful participation in the summer course, with the odds-ratio of the last everywhere exceeding the one of the first. The average treatment effect, ATE, for the success rate equals $t = 2.59$ when calculated over all five strata, and up to $t = 9.18$ when calculated over the four non-sparse populated strata, so is statistically significant at 5% level.

Summarizing the outcomes of the statistical analyses, a direct comparison of the academic success of students successfully participating in the summer course and that of the non-participants, demonstrates a large treatment effect. The treatment effect exceeds the effect of math schooling at advanced level, with math schooling at basic level as reference. However, part of this effect may be caused by selection bias due to the voluntary participation in the summer course. In order to decompose the total treatment effect into such a selection effect and a corrected treatment effect, propensity scores of summer course participation were estimated based on a very wide range of learning related students' background data. After stratification based on these propensity scores the presumption of the existence of selection bias was confirmed, and correction for this selection effect did indeed diminish the treatment effect, but still a very substantial treatment effect remained, of the size of about half of the effect size of being schooled at an advanced level.

Conclusion and Discussions

Many first year university programs contain elements of remedial education before or within the program: only after revisiting topics that have been taught in the last grades of high school, the program continues with the coverage of completely new

topics. Our study suggests that such an approach to bridging is too limited: important deficiencies exist in the mastery of more basic mathematical competencies, typically taught in junior high school. Such topics stay outside the scope of a bridging course that refreshes more advanced material from the senior high school program, leaving important deficiencies unaddressed. Based on our experiences with entry tests over a sequence of years, the UM has opted for a very broad and basic coverage of topics in our math summer course, and individual learning routes controlled by repeated administrations of adaptive, diagnostic tests. To make full use of the outcomes of adaptive and diagnostic tests, the remedial education also should be adapted to the individual level of the student. Computerized, adaptive tutorials constitute instructional tools that allow doing so; remedial education organized in classroom setting is less compatible with strong adaptability. Therefore, although in the typical European context of remedial education placement does not play a role, the use of adaptive e-tutorials has crucial benefits and needs to be stimulated.

Direct comparison of academic success of remediated and non-remediated students suggests that this kind of bridging education is very effective: the non-corrected effect of successful participation in the summer course exceeds the effect of math prior schooling at advanced level, with basic schooling as reference. The relevant research design of this study is, however, that of a quasi-experimental setup with non-equivalent groups, requiring a correction of the calculated treatment effect for potential selection effects. Correction on the basis of the propensity score method indicates that indeed part of the non-corrected treatment effect should be attributed to the circumstance that participants in the summer course possess more favourable background characteristics for achieving academic success in their study, than students who choose not to participate in the summer course. At the same time, after correcting for the non-equivalent composition of both groups, a substantial treatment effect remains, in the order of size of about half the effect size of being educated at advanced math level in high school.

From a substantial perspective, the outcomes of the effect analysis suggest that the chosen format for bridging education, to know that of an online summer course with a very broad coverage of basic math topics, and learning controlled by individual, adaptive testing, is a very efficient one to bridge math skill deficiencies. The average study load of being successful in the summer course is much less than the difference in the study loads between high school math education at an advanced versus basic level. Notwithstanding, the treatment effect of successful summer course participation is about 50% of the effect size of advanced prior math education. These conclusions are fully in line with the findings of Bahr (2008) that students who remediate successfully, perform comparably to students who are college prepared without the need for remedial assistance, whereas students who do not remediate successfully, perform considerably less favourable. The question if our outcome is unique for the chosen format of bridging education, or that other formats, like offering additional bridging classes parallel to regular education as part of the first year university program—a format used by many Dutch and European bridging initiatives—is as effective, suggests to be an important question for future research.

An alternative perspective of our study is the methodological one, and the crucial lesson to be learned from this perspective is that of the danger of overestimating effect sizes when doing educational research with experimental and control group but non-random assignment. Selection effects that take place when the treatment is voluntary, rather than based on random assignment, are typically in the direction that the more mature, better motivated students opt in, the others opt out. As a consequence, one may find a large effect, but not necessarily a large treatment effect: the second effect component, the selection effect, inflates the total effect, giving the impression of a highly successful intervention. Therefore, correction of the total effect for the non-equivalence of treatment and control groups is a real must, but the quality of such a correction is crucially dependent on the quality of the covariates. A poor set of covariates will do a bad job in calculating a corrected effect, in the sense that poor covariates will underestimate the selection effect and still result in an inflated treatment effect. Therefore, correction should be based on a large set of covariates and should include any covariate that can potentially have an impact on the decision to voluntarily participate or not. But the preference for the richest set of covariates one can think of will in general be at odds with methodological considerations: traditional, ANOVA-, and ANCOVA-based methods for effect analysis work best with small number of covariates, and classifications with limited levels. It is in this conflict that propensity score methods may have a fruitful application by allowing the use of covariate sets as rich as the one used in our empirical study, and still be in solid area with regard to methodological aspects.

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Chapter 14
Learning to Learn

Bernadette Pol

Introduction

The efficiency of teaching at higher educational institutes world-wide is a topic of discussion from the perspective of the institutions themselves as well as for individual students.

Educational institutions are primarily focused on effective and high-quality education. Therefore, effectiveness of students' learning is often expressed as study time spent related to students' achievements, measured at a certain moment in time or period of the curriculum. Research shows (Prins 1997) that study pace is primarily influenced by student-related aspects like talent, the level of self-awareness, motivation and determination, and far less by the educational programme and the educational system than one would probably expect. Educational institutions strive for education of high quality and study effectiveness which may differ from the students' personal aims like having a good time, experiencing freedom in choices, having student jobs, being active as a member of a student society and pursuing a degree with minimum effort for maximum grades.

Although first year students usually intend to obtain all study credits within the nominal study time, few actually succeed in doing so (15–20% for the course Industrial management & Engineering of the University of Twente in the period 2002–2009). Reasons for unintentional delay can be found in transition problems, getting acquainted with a new study system, and a lack of awareness of new learning approaches. Nelis and Van Sark (2009) show that young adults are developing their personal identity until the age of twenty four. Given the stage of development to be expected of 18–20 year old first-year students, they are likely to vary in their capabilities of self-directing their own learning process and personal study success. Cotrell (2003) suggests that especially the first year of academic study seems to be crucial for developing study skills. Given the focus of higher educational institutions on high-quality education and the efficiency or effectiveness of the educational

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process, the unintentional study delay of first year students is a problem for which no effective solution has been found yet.

The undergraduate programme 'Industrial Engineering and Management' (IEM) at the University of Twente in the Netherlands dealt with the problem as described above by starting a project called 'learning to learn'. The project aim was *to speed up the self directed learning skills of first year students*. The pilot took place during the academic years 2008–2009 and 2009–2010. In the project, freshmen were coached during their first semester to help them at the very beginning of the development of self-directed learning (learning to learn), with a strong emphasis on reflecting on their own study behaviour and applying study skills. Improvement of study effectiveness was not a primary goal of the project but might be an extra outcome.

This paper will describe the theoretical framework behind the project, its structure and implementation and the results achieved so far.

Theoretical Framework: Learning to Learn

For the set-up of the project the most important theories used were the *meta*-cognitive perspective from Kaldeway (1999) and Kaldeway et al. (1996), the ideas about study habits of freshmen (Cottrell 2003) and the active learning process described by Smuling et al. (1990) and by Mok and Cheng (2002).

According to Kaldeway et al. (1996), learning can be viewed from an organizational perspective; students need to think ahead and organize their study activities so as to acquire all necessary subject materials, skills or insights that are being assessed.

'Learning' is explained by Kaldeway (1999) as *acquiring new knowledge, competencies or insights* needed in a situation in which the learner does not have the knowledge, competencies or insights yet. Besides the organizational perspective, Kaldeway defines another three perspectives from which the learning process can be approached: (1) the Cognitive, (2) *Meta*-cognitive, see also Veenman and Verheij (2001), and (3) Affective perspectives (see Table 14.1). Learning how to learn can be explained from these three perspectives. From the cognitive point of view, learning to learn is seen as learning how to structure, memorize and construct schemata. The *meta*-cognitive point of view deals with knowledge, skills and insights in the personal study process. From this perspective, students learn how to adjust their own way of learning in order to achieve learning outcomes within the limits and possibilities of the corresponding learning environment. From an affective point of view, the student learns about (dealing with) personal feelings like motivation during the learning process.

According to Smuling et al. (1990), learning is an active process whereby students practice, make mistakes, learn from the mistakes by reflecting on their study behaviour, ask for help and acquire new insights in order to make lasting changes in their study behaviour. The study of Dolmans et al. (2005) stated that learning transfer can be facilitated by 'contextual learning'; by revisiting content at different times in rearranged contexts, for different purposes and from different perspectives. Cottrell

Table 14.1 Learning explained from four different perspectives on the study process. (Kaldeway 1999)

Perspective	Aim	Learning to learn
Cognitive	To use all kinds of study techniques within the learning process	Learn how to structure, memorize and construct schemata
Meta-cognitive	To acquire knowledge, skills and insights in the personal study process	Learn how to adjust the way of learning
Affective	To foster perception and experience of learning	Learn about (dealing with) personal feelings
Organizational	To organize study activities	Learn to develop a study pace and switch between different study activities

(2003) states the importance for freshmen to develop regular study habits in the first year of study. When students get insight in their own way of learning at the start of their study, they are more capable of guiding their own learning process and achieve better study results. So, catchwords for a successful learning environment seem to be: activation, reflection, feedback and practice.

These theories lead to the project 'learning to learn', with the aim '*to stimulate freshman to develop self-directing learning activities*'. This aim is concretized in two goals:

A. *Primary:* Help students to increase self-directed learning during their first semester.
B. *Secondary:* Increase study success.

Conceptual Framework: The FAM-Model

As a structure for the project the *freshmen, apprentice and master-model* (FAM-model) was chosen. This conceptual model is probably one of the oldest medieval guild educational models, based on the idea that novice workers can learn from examples that experienced workers provide (practicing through imitating skills, making mistakes, cooperating with and talking to apprentices, looking at the master's work, asking questions and receiving feedback). The FAM-model provides students with a learning environment that supports their learning process. We concretize this medieval model as shown in Fig. 14.1.

The FAM-model differs considerably from the well-known mentoring model in which older year students guide freshmen in a social context, specifically, to get introduced into the academic environment. In the mentor system there are no relations with the content of the study programme. In the project 'Learning to learn'; we are connecting first year guidance with programme content by introducing new participants; the apprentices and the master.

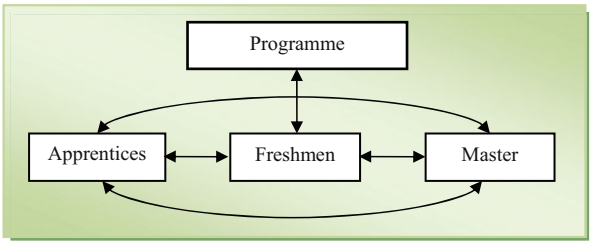

Fig. 14.1 Conceptual FAM-model concretized

In the FAM-model participants have a specific role:

- *Master:* The 'master' is a member of the academic staff and an expert on a specific theme, for instance 'Business Information System'(BIS) or skills like 'problem solving'. He introduces a meeting with in-depth knowledge and stimulates students to reflect on their personal knowledge by means of assignments and plenary feedback on group work.
- *Apprentices:* The 'apprentices' (second year students) guide ten freshmen, answer questions, share their own study experiences and challenge freshmen to share and discuss relevant issues, work on assignments, discuss problems and possible solutions, and structure and interpret group findings.
- *Freshmen:* The 'freshmen' can easily access knowledge and experiences of other freshmen, the apprentices and master. They have the opportunity to pose questions, find solutions through discussion, share their experiences and practice with assignments. Meanwhile, they learn about their own personal study and learning skills and they get insight in their own study behaviour and study success.

Structure of the Project

The project was designed and guided by five professional staff members; the project team. Per meeting a plenary room and project rooms were available for group work. Most of the assignments for group work were related to undergraduate courses, e.g. the course BIS was focused on designing an information systems and the 'learning to learn' meeting assignment was focussed on the theme 'problem solving'. Freshmen had to identify the problems within the BIS case, which could be solved with a new information system. Each meeting (1.5 hour) started with a short introduction (15 minutes) from a master. After the introduction, groups of freshmen and apprentices worked on assignments, exchanged experiences and tried to achieve individual improvements in learning (45–60 minutes) in a project room. During these group meetings freshmen's questions could be discussed with a strong focus on finding solutions together. Group findings were written down on papers. In the plenary room the papers were discussed. Feedback was given by the master (15 minutes) with special emphasis on reflection about how to improve personal learning skills to improve the learning process. An example was that groups were asked to make a mind map from a chapter of a book and present their findings in the plenary room, so freshmen

Table 14.2 Number of meetings and participants

	2008	2009
Training apprentices in hours	12	10
Preparation meetings	13	8
Learning to learn meetings	13	8
Participants (freshmen)	97	86
Apprentices	9	8
Staff involved	10	8

learned that information processing can be done in other ways then they are used to. Besides problem solving, meeting themes were for instance: feedback, academic reading, planning, etc.

Before each project meeting, a 1-hour preparation meeting was organized by the project team with the apprentices and the master(s) to discuss the current theme and assignments and to look back on the previous meeting. During the first semester of 2008, 13 meetings were organized. In 2009, we skipped the meetings with a very low rate on succesfulness, evaluated by freshmen as contributing insufficiently to learning skills. Also, we improved the eight meetings with an average or good score. Some figures of the meetings and participants are given in Table 14.2.

Recruiting of the Apprentices

The staff members recruited apprentices. Recruitment criteria were: (A) having finished at least 55 European Credits (EC) out of 60, within the first year, (B) some experience with board membership, committee work, etc. (C) good motivation and (D) good communication skills. Getting selected as an apprentice was a recognition of personal and study achievements and led to a paid job and the possibility to improve coaching skills with the guidance of professional staff. Apprentices were specially trained in communication, coaching and leadership skills.

Evaluation

To assess the success of the project, we conducted an evaluation. In the subsequent sections we describe the methodology and the most important results of the project.

We considered the project successful if the two project goals were achieved, based on the indicators mentioned below:

Help students to increase self-directed learning during their first semester.

- *Indicator 1:* 'Usefulness of meetings' as perceived by first year students. More than 50% of the freshmen should perceive the meetings as useful.
- *Indicator 2a:* 'The importance of the role of apprentices in the FAM-model'. At least 50% of the freshmen should perceive the contribution of the apprentices as important.

- *Indicator 2b:* 'The importance of the FAM-model'. At least 50% of the apprentices should perceive the FAM-model as important.

Secondary: Increase study success.

- *Indicator 1:* 'Freshmen study results'. Study results (obtained credits) should increase during the first year in comparison with two earlier cohorts.
- *Indicator 2:* 'Number of drop-outs'. The number of drop-outs should decrease during the first year in comparison with two earlier cohorts.

Methodology

To assess whether the above-mentioned project goals were fulfilled, we:

- Distributed questionnaires among freshmen 2008 (97) and 2009 (86); one at the start of the first semester and the same questionnaire again at the start of their second semester, to evaluate their improvement on personal learning skills during the first semester. Examples of subjects covered in the questionnaire included: ability of planning, information processing, making notes, etc. The questionnaire is available on request from the author (in Dutch).
- Conducted interviews with apprentices (2008 and 2009).
- Asked the apprentices to write reflection reports.
- Monitored freshmen's study results and compared them with two earlier cohorts.

Due to the fact that the project results concern a limited time period, statistical validation is not possible yet.

Evaluation Results

For each project goal and their indicators, we will discuss the results below.

Project Goal A: Help Students to Increase Self-Directed Learning during their First Semester

1) Indicator: 'Usefulness of Meetings', Results of First Year Students
In choosing this indicator we assume that if students find a meeting useful, then they get new insights. For this indicator the overall result is positive, see Table 14.3.

A total of 59 and 76% of the two groups of freshmen evaluated the project meetings as useful. This is more than the minimum of 50% that we aspired. We attribute the increased perceived usefulness in 2009 to the improved quality of assignments (we made them more concrete) and to the better preparation of the apprentices. They had

Table 14.3 Usefulness of meetings in (%), executed in 2008 and 2009

	2008 ($N = 56$)		2009 ($N = 63$)	
	Useful (%)	Not useful (%)	Useful (%)	Not useful (%)
Introduction	50	50	70	30
Feedback	43	57	52	48
Academic reading	73	27	77	23
Study planning	50	50	76	24
Tips and tricks for exams	88	12	94	6
Reflecting on results	47	53	79	23
Teamwork/collaboration	59	41	68	32
Library skills	–	–	90	10
Average	*59*	*41*	*76*	*24*

obtained insight knowledge and understanding of their role, due to the fact that they participated as freshmen in 2008.

Although participation in the project was voluntary, 70% of the freshmen participated during the first quartile in both years. A small number of freshmen did not participate at all. In the second quartile the participation decreased. Based on the results of the questionnaires, this seemed related to the time of scheduling and personal considerations like social activities. A striking observation was that many freshmen at first did not see the relevance of the project, but the second questionnaire learned that the usefulness of the meetings scored more than 50%, see Table 14.3.

Respondents in general have an optimistic view of themselves regarding their competencies at the start of their BSc study. Respondents who participated only in 0–5 meetings scored their competencies after the first semester as high as at the start of the study. For the other respondents, almost all competencies improved during the first semester in comparison to the start of the study. Overall, 66% of the respondents appreciated the project, although they just saw a small contribution of the project to the development of competencies in general. Reasons for this apparent inconsistency can be that students do not separate the acquired competencies in the project from those acquired in regular courses, or that the project indeed did not contribute to the improvement of their competencies (which we find difficult to believe).

Themes like 'self-directed learning' and 'planning' were important topics but freshmen indicated that these themes did not really appeal to them, because they already obtained these competencies in secondary education. However, they were aware that these competencies possibly were required on a higher level. On the other hand, freshmen came to realize over time that competencies still needed improvement on topics like academic reading (47%), planning (61%), study strategies (41%) and exam strategies (59%).

2a) Indicator 'the Importance of the Apprentices in the FAM-Model' as Perceived by Freshmen

As for this indicator we assume that if freshmen find the role of apprentices important then apparently the FAM-model is suitable to transfer knowledge concerning

Table 14.4 The role of the apprentices in the FAM-model in (%)

	2008 ($N = 52$)		2009 ($N = 45$)	
	Important (%)	Not important (%)	Important (%)	Not important (%)
Role of apprentices	80	20	63	37

self-directed learning and that freshmen got new insights through the guidance of apprentices (see Table 14.4).

The role of the apprentices in the FAM-model is important for freshmen.

Working in the FAM-model seems very satisfying for freshmen. The role of the apprentices is essential for creating trust and giving advice to freshman. One example of learning by means of communication between freshmen and apprentices was the meeting on 'study planning'. The majority of the freshmen were not aware of the importance of a good study planning. Most of the freshmen did not plan study activities at all. They organized their study activities haphazardly. Discussion and guidance from the apprentices on an assignment on planning eight study hours per day, including contact hours, concerning their first quartile courses changed their awareness about the necessity of catching up with their study in order to stand any chance of passing the exams. Another example was the meeting 'making notes' where apprentices showed extensive notes from first year's lectures. Freshmen were impressed and realized very soon that making notes during courses, which they often had not done before, will benefit their own study achievements.

The overall result is positive on the indicator 'the importance of the apprentices in the FAM-model', although the drop from 80 to 63% cannot be explained. Further research is necessary during the coming years.

2b) Indicator 'the Importance of the FAM-Model' as Perceived by Apprentices
All the apprentices evaluated working in the FAM-model and the variation in plenary and group sessions as very positive. Seven apprentices explicitly mentioned in their reflection report that the FAM-model works well due to the fact that freshmen feel at ease during group work and they could ask the apprentices all their questions about courses, exams and how to deal with literature and project work. They also concluded that meetings are most effective in the first quartile. At that time, freshmen are still in need of finding their way in an academic learning environment. Some apprentices even think that participation should not be voluntary but obligatory. The result is positive on the indicator 'the importance of the FAM-model as perceived by apprentices'.

As all indicators have a positive score, we conclude that project goal A was achieved.

Secondary Project Goal B: Increase Study Success

1a) Indicator 'Freshmen Study Results'
For this indicator we measured the study results of freshmen who participated in the project (drop-outs excluded). If freshmen study results increased during their

Table 14.5 Comparison of credits gained and average grades from freshman during their first year with a maximum of 60 EC nominally (drop-outs excluded)

Year	Average EC freshmen	Average grade freshmen	Finished P-exam in 1 year (%)	Average grade P-exam for those finished in 1 year
2006–2007	40.2	6.5	11	7.3
2007–2008	38.9	6.6	3	6.7
2008–2009	43.1	6.6	17	7.0
2009–2010	45.5	6.5	16	7.4

Table 14.6 Number of drop-outs

Year	Drop-outs (%)
2006–2007	28
2007–2008	29
2008–2009	19
2009–2010	20

first year in comparison with two earlier cohorts then we assume that freshmen's self-directed learning abilities increased.

The number of registered students for all 4 years was approximately 90 per year on the 1st of September. We measured their average EC gained during the first year of study of all freshmen participants in the project. We also looked at the average grades, the percentage of freshmen who finished their propedeutic (P) exam within 1 year, and their average grades. For comparison we also measured these variables for two earlier cohorts (see Table 14.5).

Table 14.5 shows an overall increase for participants in the project.

Compared to the cohorts 2006 and 2007, the average EC obtained by all freshmen participating in the project increased, as did the percentage of freshmen finishing their P-exam within 1 year. In both years, freshmen who participated in only 0–5 meetings realized a lower number of ECs then freshmen who participated regularly. Based on the increased number of study credits obtained since the start of the project, we conclude that the project was successful.

1b) Indicator 'Freshmen Drop-Outs'

The overall result on this indicator is positive, see Table 14.6.

The percentage of drop-outs decreased during the project period.

Our explanation is that during the project freshmen were stimulated to reflect on motivation, ambition and study results in relation to the chosen study programme. They were made familiar with the idea that motivation and study skills, among other issues, are important for students' study success. If studying under normal circumstances does not lead to obtaining credits, self-reflection is necessary to get a clear view on personal future goals. All freshmen have a relevant pre-university education for admission, so intelligence should not be an issue for obtaining sufficient credits. If a lack of study skills is the reason for not obtaining credits, then freshmen should ask for extra help. If self-reflection makes it clear that motivation or interest

in the programme is lacking, then freshmen should leave the programme as soon as possible.

The open communication with the masters and apprentices concerning this topic during meetings made some freshmen ask for extra help (from colleague students or apprentices) or reconsider their choice for the study. Most of the drop-out students obtained $\leq$20 EC and some freshmen realized that the chosen study did not meet their ambitions.

A word of caution: A higher percentage of drop-outs could have indicated success of the project as well because it could indicate that students decide more quickly that they should stop their study. As this did not occur, this potential explanation is irrelevant.

The project goal 'Increase study success' is achieved on the basis of the data available at this moment.

Discussions and Conclusions

Looking at the results the project seems to be successful. The FAM-method is highly appreciated by freshmen and apprentices. As for the study results, we are overall satisfied. We learned that students are motivated to make assignments within the FAM-model together with apprentices and that they especially like more practical assignments. The most beneficial results of this project are the smooth transition of the freshmen to their new study environment and their learning about how to adjust their own way of learning in order to achieve the required learning outcomes.

The apprentices in 2008 had difficulties with understanding the project aim, unlike the apprentices in 2009 who participated in the 'learning to learn' project as freshmen in 2008. As for the freshmen it is important to create an open communication, so that they feel secure within the project. If so, they give feedback on courses and lecturers as well as on the assignments and meetings of the project, which gives the educational management the possibility to improve both the project and the programme.

We conclude with some important conditions for the project to be successful. These conditions are:

- Ensure that staff members are dedicated and convinced that working with the FAM-model helps student to develop self-directed learning.
- Recruit motivated apprentices who understand the importance of their role within the project.
- Ensure good training and support for apprentices. They need to be trained before the start of the project and guided before every meeting by discussing the assignment and create an open communication for them to be creative in dealing with the topic at hand and to help freshmen develop an active learning attitude.
- Take care of inspiring and open communication between freshmen, apprentices and masters. Staff members, especially masters, have to be aware that this project is not about course knowledge but about self-directed learning.

- During meetings, keep the introduction by the master short. Freshmen want to do assignments.
- Ensure that the coordinator is dedicated and is able to convince all actors and keep them focussed.
- Schedule meetings immediately before or after other course activities, so that freshmen stay on campus.
- Relate practical assignments to current courses.

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Part V
Edineb-News

Chapter 15
Past, Present and Future of EDiNEB from the Perspectives of Participants and Management Team

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Reflections on Ten Years of Change in Higher Education and the Role of EDINEB

In the last ten years, the role of higher education and business and economics schools in particular has fundamentally changed. The complexity of society has increased dramatically with the globalisation of higher education (Den Bosch 2008b; Hagen 2008; Healey 2008; Rienties and Tempelaar 2009). The globalised market for higher education has further increased the pressure on business schools to deliver high-quality education and to attract larger numbers of (international) students with less public funding (Adcroft et al. 2010; Barsky and Catanach 2011; Rienties et al. 2012a, b).

A second major development in higher education is the increased affordance of ICT for business education (Daly 2006; Rienties and Townsend 2012). ICT tools like online assessment, discussion forums, Wikis, web-videoconferencing or virtual worlds are available for business schools to provide support and learning opportunities in new ways and to new types of learners. Within the Educational Innovation in Economics and Business (EDiNEB) network, a large number of good practices

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illustrate the power of ICT, such as master thesis supervision at a distance for adult learners (Semeijn et al. 2009), discussion opportunities for MBA participants around the globe (Pence and Wulf 2009) or helping 4,000 international students to learn and apply statistics (Tempelaar et al. 2011). However, the availability of free and open course-ware modules, such as offered by MIT, as well as (relatively) cheap online degrees issued by institutes like University of Phoenix imply that business schools are (increasingly) competing on a global scale. In other words, ICT has become both an enabler for business schools to target new audiences and markets and at the same time is challenging the current business model of business school (Barsky and Catanach 2011; Den Bosch 2008b).

A third major development in higher education is that research and evidence in business education has shown that traditional forms of education do not provide an optimal learning experience for business students. In the past, the transfer of teacher's knowledge to students was considered as a primary method of learning (Eringa and Huei-Ling 2009; Rienties and Townsend 2012; Van den Bossche et al. 2004). However, this traditional learning method is not useful for understanding and solving complex tasks and problems in a modern society (Gijselaers 1995; Hagen 2008; Van den Bossche et al. 2006). In particular, several researchers have concluded that traditional delivery of business education leads to ill-equipped business graduates who have limited practical management experience (Den Bosch 2008a, b; Hagen 2008; Pence and Wulf 2009). As a result, an active approach to learning in education has become more important, whereby a teacher-centred approach is replaced by a student-centred approach (Hernandez Nanclares et al. 2011; Pence and Wulf 2009; Van den Bossche et al. 2004). Teachers and researchers agree that these changes in business education add to a more constructivist and powerful approach to learning.

EDiNEB at the Forefront of Innovation in Economics and Business

Since 1992, the EDiNEB foundation has been at the forefront of the three major developments of globalisation, ICT and student-centred learning. Led by the inspiring pioneers and founding fathers Wim Gijselaers and Rick Milter, the EDiNEB yearly conferences and associated book-series have attracted thousands of practitioners, researchers and innovators to join the EDiNEB vibe, as always organised to perfection by Ellen Nelissen. By learning and sharing best practice and research in business and economics education, some fundamental changes in higher education have been achieved, as success stories in implementation of Problem-Based Learning at Maastricht University (Gijselaers 1995), and professional blended MBA programmes at Ohio University (Stinson and Milter 1996) in the United States have illustrated.

With the increased competition of other national and international conferences, the market for educational innovation conferences has become rather saturated in the last 5 years. In particular, for most participants, the EDiNEB is not the key discipline conference (e.g. accounting or marketing research rather than educational

innovation), and getting participants to return frequently has proved to be difficult. In combination with increased competition, the effects of the global economic downturn are still strongly visible in many areas of the conference sector (Davidson 2010): as organisations tighten their purse strings, conference participation budgets are often some of the first to be reduced. This trend has also affected EDiNEB such that since 2002, EDiNEB has experienced a slow but gradual decline in the number of participants attending the yearly conferences. In 2009, the founders of EDiNEB gave the new Management Board the task to revitalise the EDiNEB Network. This review reflects how the Management Board and EDiNEB community at large are changing the way EDiNEB is organised and what the future EDiNEB might bring.

The Long Process of Change

During the 2009 conference in Baltimore, in total 34 (45%) participants completed a questionnaire about the current and future directions of EDiNEB. The primary reasons (in order of occurrence) for participants to attend the conference were: (1) to network and interact with others, (2) to give and listen to presentations and (3) to experience the community vibe. The primary improvements regarding the conference organisation suggested by the participants were: (1) increase the number of participants, (2) structure the conference more and (3) provide more material and information beforehand.

Based upon this survey and follow-up discussions with key participants within the EDiNEB Network, the new Management Team has made six changes in the way the conference and organisation are organised. First of all, in order to attract more participants more emphasis was placed on personalised marketing and communication. This resulted in a new website as well as updated database of participants and more direct and personalised communication to participants. Second, new elements have been added to the EDiNEB conference in line with current trends in conference management. A range of authors (Vanneste 2008; Wiessner et al. 2008) have highlighted the importance of integrating learning, networking and personal enjoyment in conferences to optimise the delegate experience and encourage repeat participation. Lee and Back (2009) highlight the importance of offering a range of different educational opportunities so that delegates are ‘immersed in learning’ (p. 260). To this effect, a range of pre-conference activities were organised for participants such as online round-table sessions, webinars and providing an online platform for EDiNEB-er to share knowledge and expertise, namely LinkedIn. Also pre-conference workshops such as “the use of Second Life”, “how to get your paper accepted”, and “main challenges for business schools in the 21st Century” were introduced in order to provide participants with an opportunity for in-depth knowledge sharing.

Third, full paper hard-copy conference proceedings (Halley et al. 2010; Rienties et al. 2012c) were reintroduced in order to provide more information about the conference and revitalise the connections with researchers in business and economics education research. For several (young) researchers, having a paper published in a

conference proceeding with ISBN number is an essential requirement to receive a budget to attend a conference. Furthermore, participants are able to make a more informed choice about which session to attend based upon the full-paper descriptions rather than titles of sessions.

Fourth, the overall focus of the conference was diversified into five tracks, whereby the track chairs are responsible for the implementation of their own theme and quality control. The track chairs peer-reviewed all abstracts and papers within their track and provided support for participants based upon their expertise. By providing feedback on the full papers before, during and after the conference, the overall quality of research submitted by participants to *Advances in Business Education and Training* (ABET) or other publication venues is enhanced. Furthermore, the chief editor of ABET has raised the bar for accepting publications in order to increase the overall quality and relevance of the book series. At the same time, more support and feedback is provided to authors to help them meet the required level. By providing clearer tracks and support, the EDiNEB community provides a rather unique service to young researchers in education as well as established researchers in management and economics to publish in educational journals.

Fifth, in 2010, in order to lower the conference fees for participants in the current difficult economic times where funding is tight, the conference was organised by a local university rather than a conference venue or hotel. In addition to lower venue costs, another main advantage of this approach is that local organisers can help with raising the EDiNEB brand and solve local conference issues. In 2011, EDiNEB changed to a business model whereby the main organisational activities are conducted by the local organisation (in 2010, the Thames Valley University in London; in 2011 IDRAC in Lyons). Furthermore, a fully online system for all conference processes was put into place to support and automate the various submission and registration processes. As a result, the fixed staff costs were reduced to zero. Finally, the organisational structure of EDiNEB changed from a foundation, which was positioned at Maastricht University, to an international association that is owned by its members. As a result, we hope that members will become more involved in helping to support and run the association and make it flexible enough in the years to come.

Reflections from Participants and Members of EDiNEB

In order to better understand why some participants choose to come to the conference each year while others do not, two online questionnaires were developed and distributed. The first questionnaire developed by EDiNEB and supported by the University of Surrey consists of 50 questions and was distributed via personalised email to 200 past and current participants four weeks before the 2011 conference. The aim was to understand the underlying drivers for participants to join or to refrain from joining the EDiNEB conference. In total, 46 (65%) participants who were going to attend the 2011 conference and 24 (17%) participants who did not attend the conference but joined one of the last three EDiNEB conferences responded after two individualised reminders.

Table 15.1 Reasons for (not) joining the EDiNEB conference 2011

	Going to the 2011 conference		Not attending 2011 conference		T-test
	M	SD	M	SD	
Number of conferences attended	2.98	3.17	1.54	1.14	2.145*
Main themes of the conference	5.24	1.28	5.88	1.04	−2.074*
Keynote speakers	4.93	1.16	4.88	1.26	
Destination	5.04	1.15	5.25	1.33	
Opportunity to meet new people	5.48	0.95	5.83	1.20	
Opportunity to meet old colleagues	5.14	1.57	5.42	1.41	
Service(s) (hotel, catering, etc) provided	4.62	1.15	5.04	1.11	
New knowledge obtained	6.04	0.93	6.30	0.82	
Venue itself	4.87	1.04	5.00	1.41	
I feel involved in the programme	4.34	1.53	2.82	1.47	3.825**
I feel involved in the content of the conference well in advance	4.56	1.56	3.09	1.31	3.754**
I feel involved in discussions on topics raised during the conference well after the conference	4.46	1.42	3.50	1.37	2.602*
I feel involved to stay in touch with people you met at the conference, online	4.61	1.34	4.05	1.46	
I feel involved in the LinkedIn forum of EDiNEB	3.83	1.75	4.05	1.40	
I feel involved in the ABET Springer book series that publishes the best papers of the conference	3.98	1.73	3.71	2.03	
I feel involved in the EDINEB newsletter	3.90	1.53	3.41	1.84	
I feel involved in choosing the topics for the next year conference	3.93	1.40	2.82	1.59	2.832**
Do you think having personal involvement in the preparation of the conference is important?	1.49	0.51	1.57	0.51	
Are you a member of EDiNEB LinkedIn community?	71%		17%		

Note: Independent sample T-test, using a Likert response scale of 1 (totally disagree) to 7 (totally agree), except for first and last item

Of the respondents not attending the conference, inconvenient dates (38%), personal circumstances (38%), financial constraints (29%) were the most mentioned aspects. Only 4.2% of the respondents indicated that the topics were not interesting or relevant. Respondents who were going to attend the conference indicated that the primary reasons were keeping up with developments on international scale (96%), meeting "like-minded people" (93%), enhancing professional knowledge (93%) and giving presentations/ideas (85%).This result illustrates the importance of both learning and networking in the conference experience (Vanneste 2008).

In Table 15.1, the main elements of the conference are illustrated. In general, participants who were going to attend the conference had attended more conferences

in the past than those who were not going to attend. At the same time, quite surprisingly, the participants who were not attending the conference were more positive about the overall theme, the destination, network opportunities and new knowledge opportunities. Another crucial difference between attendees and non-attendees was the degree to which respondents felt involved in the EDiNEB Association and the conference in particular. In general, non-attendees felt less involved with the EDiNEB activities. Finally, only a small minority of 17% of non-attendees were enrolled in the LinkedIn community, while the majority of attendees were members of this community.

In addition to the quantitative responses, 15 participants added additional comments to an open question box. One attending participant indicated that the additional support provided by the track chairs to publish articles was a useful incentive to join:

> Recently I published a text to which several EDiNEB leaders contributed. I am grateful for their valuable case studies. Further, I believe this should be a goal of EDiNEB: To collaborate and publish with other scholar/practitioners. In so doing, the visibility of EDiNEB and the ideas espoused by this organization will increase.

Another participant not attending the conference indicated that:

> Well it appears that the conference serves as a "publishing" place for Maastricht folks (with ease). In addition, need to get more folks from the US. Well more folks in general. It appears that attendance is getting smaller and smaller.

Although these two comments provide only anecdotal evidence, the comments seem to support the proposition that delegates who report an involvement with EDiNEB outside of the conference are more likely to attend, whereas those who do not feel this involvement (in terms of publishing and networking) see this as one of the reasons not to attend.

As a second (post-) measurement of the success of the redesign of the EDiNEB conference, a second online questionnaire consisting of 26 questions on a Likert Response scale of 1 (= Totally disagree) to 5 (= Totally agree) was distributed one week after the 2010 and 2011 conference. Two personalised reminder mails were sent to the participants. Furthermore, as an encouragement for respondents, one book from one of the keynote speakers or membership of the EDiNEB Association was distributed among respondents. The response rate of the two conferences was 29% in 2010 and 48% in 2011.

In Table 15.2, the satisfaction scores by participants of the EDiNEB conference are illustrated with respect to the organisation, learning and quality of the sessions. All values were above the positive value of 3.5, indicating that participants in general were satisfied with the organisation and quality of the two conferences. Ninety-four percent of the participants indicated that the conference was well-organised. Eighty-five percent of the participants were satisfied with the conference venue, despite the fact that it was not organised in professional conference venue or hotel.

With respect to the quality of the conference programme, 75% of the participants were satisfied with the quality of the sessions. Quite surprisingly, keynote speakers received lower satisfaction scores than the actual sessions, which might indicate that finding and selecting appropriate keynotes that fit the needs of each participant is

Table 15.2 Satisfaction of organisation, learning and quality of EDiNEB conference in 2010/2011

	2010		2011	
	M	SD	M	SD
Organisation and catering				
I think that the conference was well-organised	4.66	0.67	4.44	0.79
I think that the location of the conference was appropriate	4.52	0.69	4.32	0.88
I think that the catering of the food/drinks at the conference was good	4.14	0.99	3.91	1.11
I liked the social event	4.58	0.58	4.23	0.95
I am satisfied about the overall support by the EDINEB conference organisers	4.76	0.51	4.41	0.82
Learning and quality of sessions				
In general, the sessions I attended were of good quality	4.07	0.66	4.25	0.80
I learned a lot from attending the sessions	4.04	0.69	4.00	0.92
I think that the scientific quality of the sessions was good	3.85	0.82	3.59	0.95
I think that the practical quality of the sessions was good	3.86	0.93	3.78	0.91
Overall, I'm pleased with the overall quality of the sessions	4.07	0.73	4.22	0.75
The keynotes were interesting	3.95	1.02	3.93	0.88
The keynotes were relevant for my specific interests	3.54	1.07	3.58	0.95
I would recommend the EDINEB conference to my colleagues	4.56	0.70	4.31	0.69
I will attend the next EDINEB conference	4.04	0.96	3.77	0.99
The conference proceedings were useful	4.46	0.88	4.41	0.67
There were a sufficient number of interesting sessions that I could attend	4.14	0.80	4.00	0.76

Note: Likert response scale from 1 (= totally disagree) to 5 (= totally agree)

rather complex. Eighty-five percent of the respondents indicated that they would recommend EDiNEB to their colleagues. Despite these positive responses, only 56% of the participants were positive about the question whether they would attend the next EDiNEB conference. This figure indicates how particular efforts in terms of retention management may be needed to turn delegate satisfaction into repeat participation.

The qualitative comments provided some further insights into why participants were both positive but sceptical at the same time. Two participants noted that

> This was a fabulous conference. I liked the collegial feeling among members and presenters. I found it a great place to share ideas, to network among like-minded people, and the mix of practitioners and academics.
>
> The EDINEB conference was the 5th at which I was presenting in 4 weeks after having attended others in Toronto, Istanbul, Poznan, Poland and Dublin, Ireland. I found the EDINEB conference the most interesting. The networking was great, the social activities excellent, good food and the recommended hotel was a clean, efficient hotel. Keep up with the good work.

However, another participant of the EDiNEB 2011 conference noted that although the conference was appropriate, some of the organisational aspects could be improved in the future:

> Very useful, friendly and well-organised conference, but for extra creme would have appreciated:—better instructions pre-conference (how to find it, mini tourist-guide, etc),—optional group meal organised for the night before the conference starts,—more interactive sessions/workshops,—ending the conf with a keynote to avoid the final-day drifting!

One participant from the EDiNEB 2010 conference noted that the conference was heavily skewed towards two institutions and had a redundancy of topics:

> I did not focus on a particular track but rather on specific topics irrespective of track. I do feel that there was a bit too much redundancy on some topics, i.e. too many of the TVU internship material and too many Maastricht presentations and not enough diversity of topics or speakers from my perspective. However, I did find several highly relevant presentations that made the conference a success for me.

Another participant of the EDiNEB 2011 conference also noted that the value for money is not completely in line with previous experiences:

> The conference is quite expensive if you compare it to other initiatives in an educational context. Cfr. catering: lunches were OK, but coffee breaks were of poor quality. The procedure to hand in a proposal—be selected—price you have to pay as a speaker—etc. were not very clear. Once I started asking questions and at the conference, the organising committee was very helpful though and service was excellent. Thank you for that!

The Future of EDiNEB

In the last two years, the new Management Team has made a range of fundamental changes in the way the EDiNEB conference, the book-series, and network activities are organised. Given the challenges in higher education and business and economics education in particular, it is essential that EDiNEB keeps on the forefront of innovation in learning and teaching but at the same time provides value for money and a high-quality experience to participants and members of EDiNEB. The six changes implemented by the Management Team are a first step in revitalising the network. Although we acknowledge the important role of Maastricht University in providing a stable platform for EDiNEB in the last 17 years, we believe that for the long-term survival it is essential that members across the world feel involved in the EDiNEB Network and Association.

By establishing yearly members' meetings and making the processes and decisions transparent and by maximising the duration that Management Team members can remain in the board, we aim to create a network that is beneficial for its members and is run by its members. Although we are still in a long process of change, the preliminary indications are promising. For the first time in a long while, the EDiNEB 2011 conference was profitable due to substantial cost-savings and local involvement by IDRAC. Despite these cost-savings, which inevitably had an impact on the overall quality of the service provided at the conference (i.e. catering, venue), participants

were overall very satisfied with the organisation and quality of the 2011 conference. Furthermore, the number of institutions attending the conference was more diverse than before, while the dominance of one or two institutions was less explicit. Further efforts will be made to maintain the existing delegate base and to increase the attractiveness of the conference to existing members who chose not to attend in 2011. Particular attention will be paid to retention management and re-engaging with members who have attended the conference in the past but no longer do so. The questionnaire findings have shown that those who feel involved with EDiNEB pre- and post-conference are more likely to attend the conference itself—involvement and engagement could thus be particular areas of priority in the future. The opportunities for engagement provided by the pre- and post-conference activities that have recently been introduced need to be examined so that they can be developed to their full potential in years to come. The management board also intends to develop key partnerships with other similar conferences and organisations in order to create more networking opportunities and develop alliances for the sharing of best practice and increase conference membership.

Finally, with some new and enthusiastic members willing to help, we expect a prosperous future for EDiNEB and education and innovation in Economics and Business. If you want to help, please join us at http://www.edineb.org/.

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