

*Research Article***Importance of peer support and tutor involvement in entrepreneurship education for overseas Bioscience students**P C Mitchell¹ and A E McKeown²

¹*School of Biomedical Sciences, University of Ulster, Cromore Road, Coleraine, Co. Londonderry, BT52 1SA, Northern Ireland, and* ²*The Business Institute, University of Ulster at Jordanstown, Shore Road, Newtownabbey, Co. Antrim BT37 0QB, Northern Ireland*

*Date received: 20/9/03**Date accepted: 17/11/03***Abstract**

An increasing number of Bioscience courses embed entrepreneurship learning outcomes within the curriculum, across a number of modules and/or within a dedicated module. The level 2, Developing People and Products module is one such example, involving students in 100 study effort hours over 7 weeks. This module was delivered to students (n=37) from Hong Kong, who were bridging to final year BSc Hons Biotechnology and BSc Hons Food Technology Management, by a blend of distance and face-to-face activities. The module was evaluated in week 7 by a student questionnaire. The Biotechnology cohort was identified as less likely (99% confidence level) to consider starting a business, which appears to relate to related career aspirations. Although 39% of the students had no business background, they prioritized "knowledge of business" as the best thing associated with the module, and agreed the module was effective in developing their understanding of venture creation. A significant correlation (99.9% confidence level) between "venture creation knowledge" and "peer support" was found. Tutor involvement, "experiencing" venture creation and effective group-work were agreed to be most useful in supporting students' learning. The attitudes of Bioscience students to venture creation, before and several years after graduation should be researched.

Keywords: bioscience, peer support, entrepreneurship, overseas students, undergraduate education

Introduction

Entrepreneurship is difficult to accurately define. Fundamentally it is a process of creating value, be it by individuals or organizations (Evans and Volery, 2001), and this process involves recognition of the opportunity and use of resources. However, it is not a simple process but one, which will probably require the entrepreneur or entrepreneurial organization to modify the venture concept and strategy until it is right (Good, 2003).

Entrepreneurship has emerged as a key issue and policy tool for economic growth, regional development and job creation (Laukkanen, 2000). For example, in Northern Ireland there is a vision to create a culture and environment within which the region will prosper by using its knowledge, skills and capacity to innovate (DETINI, 2002). The two Universities in Northern

Ireland have a very important role to play in innovation, not only in creating and transferring new knowledge but in forging links with other organizations. Through the Science Enterprise Challenge, under the Office of Science and Technology (OST), both Universities successfully bid for funds to establish the Northern Ireland Centre for Entrepreneurship (NICENT). NICENT is working to embed a culture of entrepreneurship and innovation in every science, engineering and informatics student on every course within its OST constituent (NICENT, 2003 a).

Entrepreneurship education

The critical role of the university in entrepreneurship education is recognized (Menzies, 2003):

1. to provide “for credit” courses as electives for Business and Management students and more recently for non-business students; and
2. to encourage and nurture self employment, small business creation and growth, and the creation of potential high growth start-ups.

According to Laukkanen (2000) the dominant paradigm is entrepreneurship education is moulding entrepreneurial individuals, informed by the theories of venture creation and commonly building on business schools’ traditionally function-oriented curricula. However, within the context of the action-oriented “entrepreneurial individual” there has been a shift from success as a function of the “right human traits and characteristics’ to a combination of human, venture and environmental conditions. This newer form of entrepreneurship education focuses on entrepreneurship as a career process of multiple new ventures, which values hands-on experience working with ventures, and the essential skills of networking or “entrepreneurial know-how” (Solomon et al., 2002). However, Menzies (2003) and Morrison and Johnston (2003) stress that academic justification for the inclusion of entrepreneurship education within the OST constituent should not be based on the false expectation that most students will go on to start businesses but rather that they will benefit from enhanced personal creativity, innovation, team-working and employability. Entrepreneurship education manifests itself through a diversity of programmes as illustrated by Menzies (2003). According to Solomon et al. (2002), it is common practice to provide students with opportunities to “experience” entrepreneurship through venture plan writing, case studies, reading, and lectures by guest speakers and entrepreneurial academics. This “experience” can even allow groups of UK students to manage their own business as part of the curriculum in Higher Education through the Young Enterprise Graduate Programme (Trainer, 2003). However, pedagogy is changing for a variety of reasons, including the growing trend to design courses specifically for non-business students. Bernardi et al. (2003) outline four design principles for an entrepreneurship course delivered to business and engineering students which can be summarised as i) attention to the students’ attitude to entrepreneurship, ii) developing knowledge, and especially skills and capabilities, iii) covering all aspects of entrepreneurial life and iv) developing the ability to work and collaborate with others. Vyakarnam (2002), with reference to the OST constituent, recommends that an entrepreneurial culture be developed by, i) learning about it, ii) doing it and iii) involving entrepreneurs.

Distance learning

Computer-mediated communications (CMC) if used effectively provides a powerful tool to support overseas students. CMC is primarily text-based and has a very important role in tutoring online (Phillips et al., 2000). Within a framework for effective online learning, CMC is primarily about the structures, motivations, assistances and connections used to support learning (Oliver, 1999), Oliver's framework also includes learning activities such as reading, projects, collaborative tasks and assessments, and learning resources such as study notes, text books, journals, Web pages and Web links (Hunter, 2003). The World Wide Web (WWW) as a means of communication and distribution of information and knowledge via the Internet (Rius-Riu, 2002) can be used within all three elements of Oliver's framework. However, O'Leary (2002) states: "Creating Internet resources that are stimulating, appealing, easy to use and educationally sound is time consuming and requires considerable expertise." Thus the use of Virtual Learning Environments (VLEs) that aim to support learning and teaching activities across the Internet have grown in popularity with educators who want to create resources quickly and without the need to develop technical skills (O'Leary, 2002). Applications of VLEs in biomedical sciences are well established (Ryan et al, 2000). The use of Web-supported learning to overseas students presents challenges, including the ability to balance both work and group benefit and on and off-line group work, incentives for enough students to participate, making correct assumptions about what is obvious to students, and ensuring students have access to quality computer facilities (Jackson, 2003).

Developing People and Products module

The Developing People and Products module was developed by the authors as an integral part of a summer Bridging Course for Higher Diploma graduates from Hong Kong to final year of a BSc Hons programme at the University of Ulster in 1996/1997. The principles underpinning the design of this level 2 module are summarized in Figure 1.

DESIGN PRINCIPLES

- Attention is paid to highlight how the significant outcomes of the module underpin final year studies and employability.
- Knowledge of essential business and management principles is developed along with transferable skills and capabilities in information technology.
- Students “experience” the entrepreneurial process within the context of their subject.
- A process driven approach is adopted, identifying possible inputs which are likely to be required to produce the elements of a business plan.
- Students work together and participate positively towards the desired outcomes

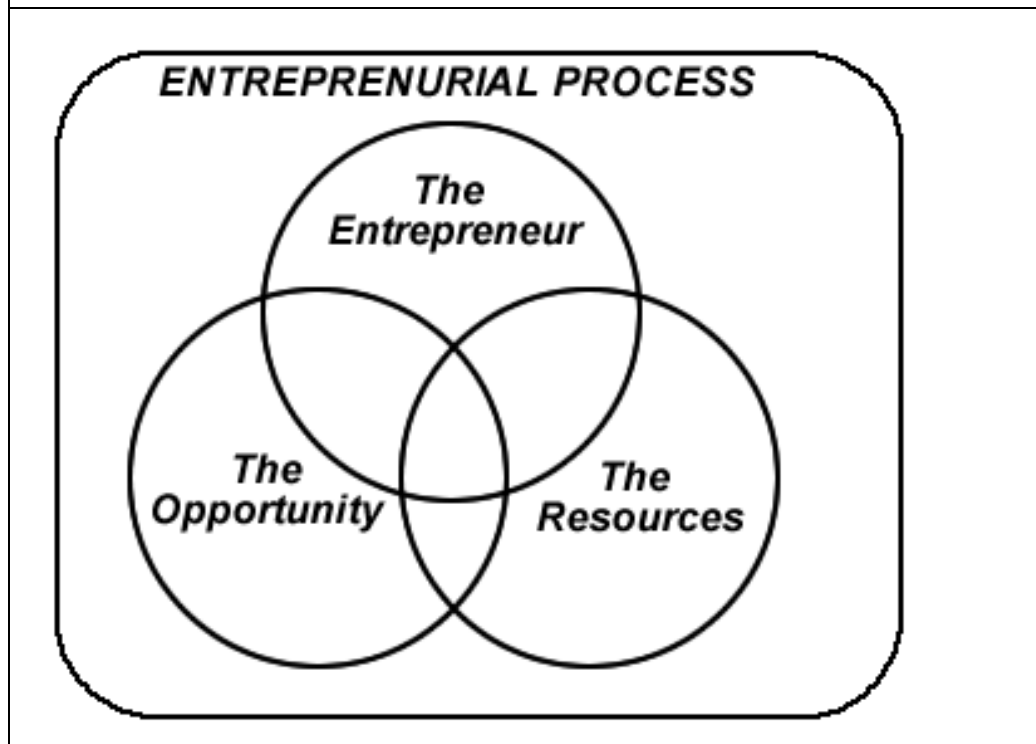


Figure 1: Design of the Developing People and Products module

Greater emphasis is placed on a “need to know basis”, “structured learning experience” and “peer and tutor support” than if the module was designed for business students.

Figure 2 highlights the importance placed on skills development but not at the expense of sound enterprise principles and practice.

The skills of communication, team working, information technology and research (marketing in this context) within the subject area, are particularly important to develop in students from closely matched courses bridging from level 2 studies at one institution to final year undergraduate (level 3) studies at university. At Ulster, successful bridging students progress to develop level 3 skills in entrepreneurship, primarily through an Exploitation of Biotechnology module.

The delivery of the Developing in People and Products module evolved in response to student feedback and teaching innovations through the use of more learning resources related to Bioscience, and inclusion of a virtual learning environment. First Class and Blackboard were used to support face-

ENTERPRISE KNOWLEDGE AND UNDERSTANDING				
<i>INNOVATION</i>	<i>MARKETING</i>	<i>OPERATIONS</i>	<i>PEOPLE</i>	<i>FINANCE</i>
Generating ideas	Marketing research	Processes	Recruitment and selection	Cash, profit and assets
Screening options	Marketing mix	Quality assurance	Motivation and rewards	Budgets and business plans
Selecting the best option	Marketing planning	Suppliers	Appraisal and Training	Sources of finance
TRANSFERABLE SKILLS				
<i>MANAGING YOURSELF</i>	<i>WORKING IN GROUPS</i>	<i>MANAGING PROJECTS</i>	<i>COMMUNICATIONS</i>	
Managing your time	Managing meetings	Planning	Using information technology	
Coping with stress	Making decisions	Implementing	Making presentations	
Setting priorities and delegating	Solving problems	Monitoring and controlling	Writing reports	
USING COMMUNICATIONS AND INFORMATION TECHNOLOGY				
<i>MS OFFICE</i>	<i>E-MAIL</i>	<i>INTERNET</i>	<i>VIRTUAL LEARNING ENVIRONMENT</i>	
Word processing Word	Reading and composing	Accessing	Announcements	
Presentations PowerPoint	Attaching	Surfing	Online resources	
Spreadsheets Excel	Forwarding	Searching	Discussions and chat	
APPLIED TO PLANNING A NEW FOOD OR BIOSCIENCE VENTURE				

Figure 2: Content of the Developing People and Products module

to-face sessions and online materials in 1999/2000 and 2000/2001 respectively. Evaluation of the on-campus Bridging Course, comprising the Developing People and Products module and a Transferable Skills in Bioscience module, taken by 31 students from Hong Kong in 2000/2001, over a period of 6 weeks, highlighted the value of the experience but identified that the majority of the students wanted more time in Hong Kong before arriving on-campus. Thus the Bridging Course was redesigned in 2001/2002 to deliver the Developing People and Products module primarily by distance learning over four weeks, but incorporating some of the module activities into the on-campus component, which lasted a further three weeks.

This study

The overall aim of the study is to evaluate the students' learning experience on the Developing People and Products module in summer 2002. To achieve this overall aim the following specific objectives were set:

1. To determine how useful students found the range of teaching, learning and assessment activities within the Developing People and Products module;
2. To determine what knowledge, skills and attitudes the students believed they developed through the Developing People and Products module, and any correlations with usefulness of teaching, learning and assessment activities;
3. To determine the effect of subject area (Biotechnology and Food Technology Management) on the students' learning experience within the Developing People and Products module.

Materials and Methods

The Developing People and Products module was delivered between 22nd July 2002 (precourse, week 1) and 2nd September 2002 (week 7). The distance learning component was designed to involve the students in 70 effort hours from weeks 1 to 4 (see Table 1).

Table 1: Schedule for the distance learning phase of the Developing People and Products module

WEEK	PAPER-BASED	VIRTUAL LEARNING ENVIRONMENT (VLE)
1	<ul style="list-style-type: none"> • Module descriptor • Step-by-step weekly guide • Study notes with the full content of the module 	<ul style="list-style-type: none"> • Registration on the VLE • Induction on using VLE • Post "personal profile" • Review Module briefing online resources and do activities • Student-led group formation aided by e-mail & telephone • Set-up "group work areas"
2	<ul style="list-style-type: none"> • Directed reading • Search for relevant journals 	<ul style="list-style-type: none"> • Review Innovation/marketing online resources and do activities • Group chat with tutor on module requirements • Group discussion to create ideas • Review example of new venture idea communication
3	<ul style="list-style-type: none"> • Directed reading • Use "marketing" agenda • Source extra information 	<ul style="list-style-type: none"> • Review operations/people online resources and do activities • Groups chat with tutor to select "the new venture idea (proposition)" • Group discussion to develop the "proposition" • Submit "idea" for assessment • Review business plan example
4	<ul style="list-style-type: none"> • Directed reading • Use "people" / "operations" agendas 	<ul style="list-style-type: none"> • Review finance online resources • Group chat with tutor on fully describing product(s) and first customers • Group discussion to develop "outline plan" • Submit "outline plan" for assessment

CommunityZero (Ramius Corporation, 2001) was chosen as the VLE because at that time it was free, and students could apply for membership of the dedicated community created by the mentor for the Developing People and Product module and quickly be approved by either the mentor or tutor. Registration on a VLE licensed to the university, namely First Class and WebCT, could not be ensured within the timescale of three weeks between confirming offers to the students and commencement of the precourse week 1. On week 5, the students traveled to Ulster for the workshop on 23rd August 2002. The on-campus component was designed to involve the students in 30 effort hours, inclusive of the business plan presentations on week 7 (see Table 2).

Table 2: Schedule for the on-campus phase of the Developing People and Products module

WEEK	PAPER-BASED	VIRTUAL LEARNING ENVIRONMENT (VLE)	FACE-TO-FACE
5	<ul style="list-style-type: none"> • Use "finance" agenda • Use library resources 	<ul style="list-style-type: none"> • Do online finance activities • Email sections of business plan to tutor for feedback • Group discussion to develop business plan 	<ul style="list-style-type: none"> • One day workshop with the mentor and tutor to outline group propositions to their peers, review finance key points, and progress their group business plans
6	<ul style="list-style-type: none"> • Use all 4 agendas • Use library resources 	<ul style="list-style-type: none"> • Email sections of business plan to tutor for feedback • Group discussion to develop business plan 	<ul style="list-style-type: none"> • Group meeting with the tutor to help progress the business plan report and presentation
7		<ul style="list-style-type: none"> • Submit business plan report for assessment 	<ul style="list-style-type: none"> • Group PowerPoint presentation assessed by a panel on day 1 of the week

Learning activities

Learning activities were built into the VLE, the study notes for the module, group assignment and module evaluation. Activities on the VLE comprised registration, a virtual tour, introducing oneself, reflection on module expectations, entrepreneurship test, and formation of the groups (4 or 5 per group within a subject area). Students were directed in their week-by-week reading of the study notes. The assignment took the form of an entrepreneurial business planning project which required each group to create business ideas within the subject area, evaluate and select a business idea, carry out exploratory market research, develop the business proposition, and use marketing, operations, people and finance agendas to develop their business plan. Each group presented a diagrammatic presentation of their business idea, outline plan of the business proposition, a written business plan report and a PowerPoint presentation of the business plan to a Panel. Each group member completed a module evaluation questionnaire.

Learning resources

Learning resources comprised hard copies of the study notes and the step-by-step guide distributed to students via the university's officer in Hong Kong, and the VLE designed and set up by the mentor and administered by a tutor. The VLE supported online resources, files and members. The web links covered getting started, innovation, marketing, operations, people and finance. PowerPoint and Word files were posted for the module briefing, pre-course week 1 to week 4 content, on-campus- weeks 5-7 content, membership of each group, examples of how to diagrammatically present a business proposition on 1 page and a written outline plan on 4 pages, and feedback on work from the tutor. Each member had access to the user name, name, joined date and last visit date for all members of the community dedicated to the module.

Learning support

Learning support was provided by an e-learning mentor and entrepreneurship expert (McKeown), and a Bioscience online tutor trained in entrepreneurship and e-learning (Mitchell), through the VLE, email, a workshop and a tutorial. Peer support, within and between groups, occurred by email and telephone during weeks 1 to 4, and face-to-face during weeks 5 and 6. Email addresses for all students and staff were available. The announcement, discussion, calendar and chat functions of the VLE were used. Key messages were posted on the announcement board by the tutor to help direct student effort in follow up to chat, email enquiries and submission of work. Activities were posted on the discussion board by staff for individual response by students, and subsequent feedback from staff and students. One scheduled chat per group was arranged per week by the tutor through email with the weekly group leader and posted by the tutor on the Calendar. Each chat session, lasting 30 minutes, had an agenda which comprised 3 points set by the tutor, was led by the group leader with input when necessary from the tutor and was summarized by a recorder who emailed the record to the tutor and group members. The workshop in week 5 required each group to brief their peers on their business proposition, and enabled the mentor and tutor to review finance principles and offer advice to each group. A face-to-face meeting by the tutor with each group in week 6 helped in the preparation of the presentations and the written business plans.

Module evaluation

21 (5 male) of the 22 Biotechnology students and all 15 (6 male) of the Food Technology Management students evaluated the module, through completion of an individual anonymous questionnaire, immediately after a brief feedback session by the mentor and tutor on their group business plan presentations. Students were asked to indicate their course, and then complete both sections of the questionnaire. Section 1 of the questionnaire required each student to indicate his or her level of agreement on a five point hedonic scale (strongly agree, agree, neutral, disagree, strongly disagree) with a series of statements, which were divided into five blocks

1. Usefulness of different teaching and learning activities (11 questions)
2. Use of personal hard copy of the study notes (8 questions)

3. Usefulness of assessment and feedback provided (7 questions)
4. Perceived further development of key skills and enterprise knowledge (6 questions)
5. Overall experience and its value (7 questions)

Section 2 of the questionnaire required each student to give an open response to three questions:

1. What were the three best things associated with the module?
2. What three things on the module did you find most difficult?
3. What three things could have been done to improve your learning experience on the module?

Statistical analysis

Ordinal scale data (1 = strongly agree, 2 = agree, 3 = neutral, 4 = disagree, 5 = strongly disagree) arising from the response of students (n = 36) to all 39 statements about their learning experience on the module was analysed. The frequency distribution of selected process (teaching, learning and assessment activities) variables and outcome variables (knowledge, skills and attitudes) were plotted using Microsoft Excel 2000. The relationship between two variables was measured using Correlation on ranked data, within MINITAB 13 for Windows, to obtain Spearman's rank correlation coefficient. Significant differences at the 95% confidence level between Biotechnology (n=21) and Food Technology Management (n=15) cohorts for specified variables were measured using the Mann Whitney, non parametric test, within MINITAB 13 for Windows.

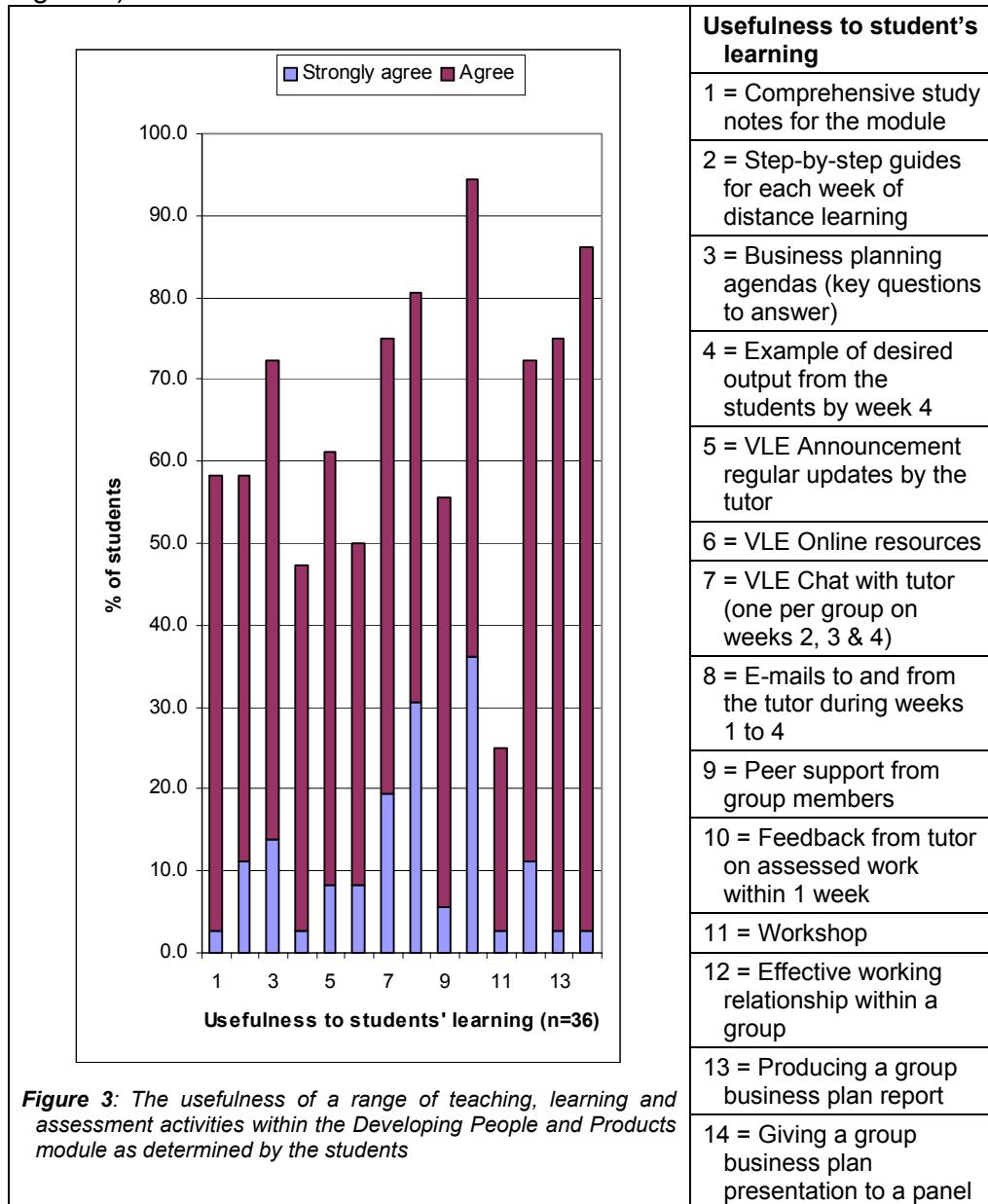
Content analysis

The comments by students in response to the open ended questions were interpreted and placed in themes defined by the tutor for each of the three issues addressed (best, most difficult, improve). The frequency of student comments falling within any one theme was counted.

Results and Discussion

Usefulness to students' learning

The three most important elements which students found useful in supporting their learning within this model of entrepreneurship awareness education were tutor involvement, "experiencing" entrepreneurship through business plan development and communication, and working effectively as a group (see Figure 3).

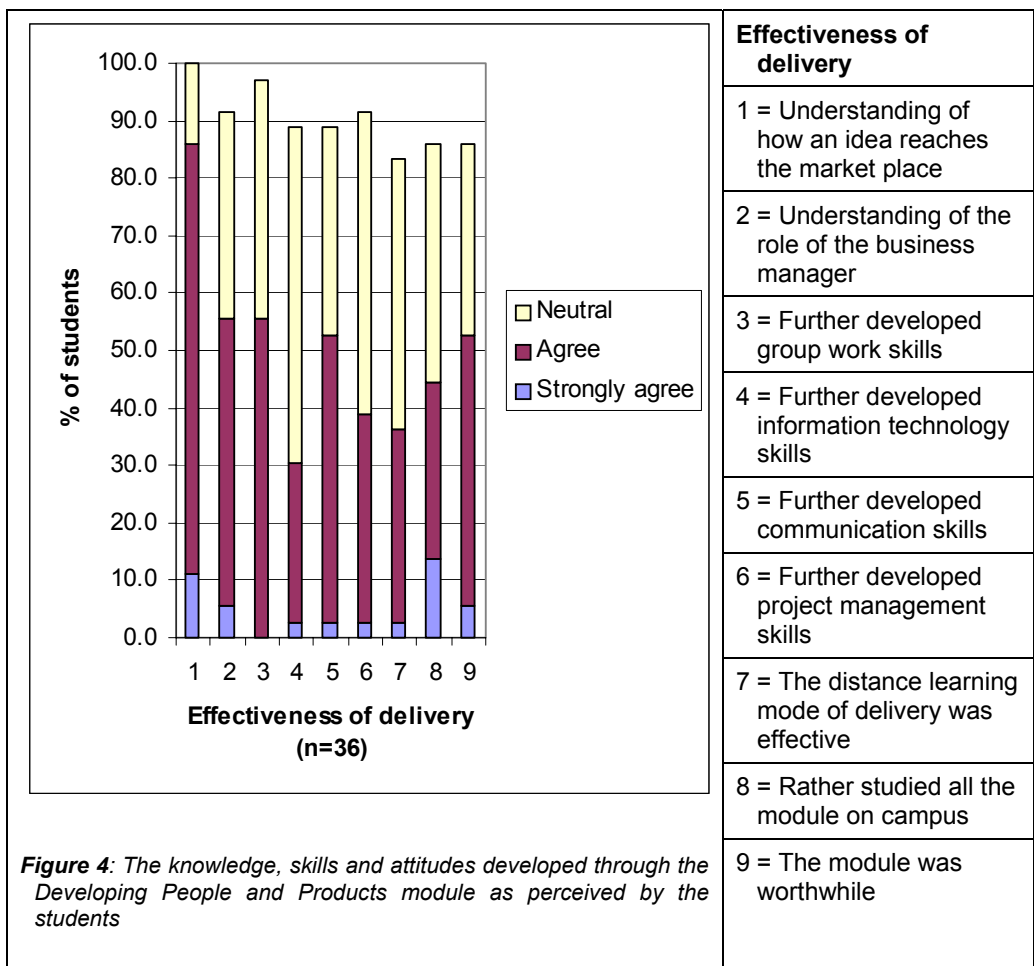


The value of formative and summative assessment feedback to each group was agreed by 94% of the students to be useful. In agreement with Philips et al. (2000), chat, email communications and the posting of notices on the VLE were also found to be useful forms of tutor involvement. "Experience" of business planning as reported by Solomon et al. (2002) and Atkinson (2003)

was found to be comparable in usefulness to tutor involvement, although more students “strongly agreed” on the usefulness of the later. In contrast, to the individualistic entrepreneurship educational model (Laukkanen, 2000; Solomon et al., 2002; Atkinson, 2003; and Bernardi et al., 2003), this study supports the usefulness of group work (see Figure 3). Lack of an “entrepreneurial” attitude by some Bioscience students is believed to be a factor behind the usefulness of group work as such students will receive encouragement, support and pressure to contribute from other members. The low level of agreement on usefulness of the traditional face-to-face session (workshop) highlights a weakness in module delivery. At this stage, each group wanted “specific” input from the mentor and tutor to advance its business plan, and not the “one solution fits all” workshop. However, the follow up meeting that each group had with the tutor appeared to meet students’ needs for targeted support in business planning.

Knowledge, skills and attitudes developed

At the end of the module, 86% of the students agreed that they understood how an idea reached the market place (see Figure 4).



Given that knowledge of venture creation is central to entrepreneurship education (Solomon et al., 2002), this finding supports the value of this approach to entrepreneurship awareness education for Bioscience students. A significant correlation (test significance value < 0.01) between “venture creation knowledge” and “peer support” was found (see Table 3). Although, no other significant correlations were found for “venture creation knowledge”, it was noted that “effectiveness of distance learning delivery” gave a test significance value of 0.053. A possible explanation can be derived from the central requirement for the students to work as an online group, with the aid of an online tutor and study notes, to create and plan a “virtual” venture. Thus students who found this approach less effective were not able to learn as effectively about “venture creation”.

At the end of the module, 56% of the students agreed and a further 36% were neutral that they understood the role of the business manager (see Figure 4). It is important that the students understand essential enterprise principles (Solomon et al., 2002) so this result might indicate a weakness in the module’s ability to deliver these for some students. Enterprise principles were designed to be delivered through learning resources and activities, with minimal support from the tutor. Although, 58% of the students agreed the comprehensive study notes were useful (see Figure 3), there was evidence that some overseas students were not reading all the notes due to limitations on their time and use of English. A significant correlation (test significance value < 0.05) between “business manager knowledge” and “effectiveness of distance learning delivery” was found (see Table 3). No other significant correlations were found for “business manager knowledge”. Once again, the effectiveness of learning is related to learning style of the student, however, unlike “venture creation knowledge” where peer support was influential, acquiring “business manager knowledge” is student centred.

Between 31% and 56% of the students agreed, and 3% and 11% disagreed that they further developed their group-work, communication, project management and information technology (IT) skills through the module (see Figure 4). Such a result was expected as importance is placed on the development of transferable skills within the final year Higher Diploma curriculum, and use of information and communication technology is widespread within education, commerce and the community in Hong Kong. A significant correlation (test significance value < 0.01) between “further developed communication skills” and “The VLE announcements” was found (see Table 3). It is believed that regular announcements by the tutor were being read for study purposes, thus helping to improve the “use of English” for some of the students. A significant correlation (test significance value < 0.01) between “further developed IT skills” and “effectiveness of distance learning delivery” was found (see Table 3). Although widespread users of IT, none of the students had used a VLE before. Thus students who looked more positively on this learning experience were more likely to recognize the VLE experience as offering opportunities for additional IT skills development. A significant correlation (test significance value < 0.05) between “further developed IT skills” and “business planning assignment” was also found. As this assignment involved the use of the Internet, a VLE, MS Excel, MS Word

and MS PowerPoint, it is not surprising that a significant correlation was found. A significant correlation (test significance value < 0.05) between “further developed project management skills” and “step-by-step guides” was found (see Table 3).

Table 3: Significant correlations between specified outcomes from the Developing People and Products module and the usefulness of specific teaching, learning and assessment activities within the module (n=36). Students indicated their level of agreement with statements [1= strongly agree; 2=agree; 3 = neutral; 4 = disagree; 5 =strongly disagree]

Dependent variable	Independent variable	Spearman's rho	Level of significance
The module was worthwhile	Business plan assignment was useful	0.508	**
	Workshop was useful	0.345	*
Understand how an idea reaches the market place	The peers in my group supported my learning	0.423	**
Understand the role of the business manager	Distance learning was effective	0.334	*
Further developed group work skills	Workshop was useful	0.289	NS
Further developed IT skills	Distance learning was effective	0.458	**
	Business plan assignment was useful	0.346	*
Further developed communication skills	The VLE announcements supported my learning	0.464	**
Further developed project management skills	The step-by-step guides supported my learning	0.358	*

NS = Not significant (test significance value > 0.05)

* = Significant (0.01 < test significance value <=0.05)

** = Very significant (0.001 < test significance value <=0.01)

Scientists understand processes thus it is not surprising that a step-by-step guide is valued by such students as a project management tool. No significant correlations were found for “further developed group work skills”.

At the end of the module, 52% of the students agreed and a further 31% were neutral that the module was worthwhile (see Figure 4). It believed that attitude to entrepreneurship as highlighted by Bernardi et al. (2003) is a factor in this result. Only 36% of the students agreed and a further 31% disagreed that they would consider starting their own business at some stage in their career. Thus for those students primarily motivated by the pursuit of a scientific career, study effort hours devoted to “entrepreneurial” knowledge and skills is time that could have been better spent on scientific endeavour. A significant correlation (test significance value < 0.01) between “module was worthwhile” and “business planning assignment” was found (see Table 3). Thus students who valued the participative learning associated with creating and planning their own “virtual” venture valued the module.

Differences between the student cohorts

The only significant differences identified between the Biotechnology and Food Technology Management students were in attitudes (see Table 4).

Table 4: Effect of subject area on the students' learning experience within the Developing People and Products module (Biotechnology = 21 and Food Technology Management= 15)

INPUT FACTORS ASSOCIATED WITH THE LEARNING EXPERIENCE			
Students indicated their level of agreement with statements [1= strongly agree; 2=agree; 3 = neutral; 4 = disagree; 5 =strongly disagree]	Median Biotech (n=21)	Median Fd Tc Mgt (n=15)	Test significance (two-tailed)
I will consider starting my own business at some stage in my career	4	2	**
The study notes were useful	3	2	NS
The VLE discussion board was useful	3	2	NS
The VLE online resources were useful	3	2	NS
Peer support within my group was useful	2	3	NS
I would rather have face-to-face delivery	3	2	NS
The work load was excessive	2	3	*
OUTPUT FACTORS ASSOCIATED WITH THE LEARNING EXPERIENCE			
Students indicated their level of agreements with statements [1= strongly agree; 2=agree; 3 = neutral; 4 = disagree; 5 =strongly disagree]	Median Biotech (n=21)	Median Fd Tc Mgt (n=15)	Test significance (two-tailed)
I now better understand the role of the business manager	2	3	NS
The module was worthwhile	3	2	*

NS = Not significant (test significance value > 0.05)

* = Significant (0.01 < test significance value <=0.05)

** = Very significant (0.001 < test significance value <=0.01)

There were no differences between the two cohorts in usefulness of the learning, teaching and assessment activities, and knowledge and skills gained during the module. The median responses of Biotechnology and Food Technology Management students to “consider starting their own business at some stage in their career” were disagree and agree respectively, giving rise to a significant difference (test significance value < 0.01). Those bridging to BSc Hons Food Technology Management are often motivated by taking a further step on the ladder to becoming a technical manager, whereas those bridging to BSc Hons Biotechnology are often motivated by science and the international excellence in Pharmaceutical Biotechnology research at Ulster. A significant difference (test significance value < 0.05) between the two cohorts of students was found in their responses to “the module was worthwhile”. This was not surprising given the respective scientific and management orientations of the Biotechnology and Food Technology Management students. The median responses of Biotechnology and Food Technology Management students to “the work load was excessive” were agree and neutral respectively, giving rise to a significant difference (test

significance value < 0.05). Whilst the work load needs to be reviewed, it is believed that the negative attitude to entrepreneurship of some of the Biotechnology students resulted in what they considered to be an acceptable work load for the module as something less than the 100 student effort hours.

Both student cohorts prioritized “knowledge of business” as the best thing about the module (see Table 5).

Table 5: The Food Technology Management (n=15) and Biotechnology (n=21) students' evaluation of the best things, most difficult aspects and areas for improvement on the Developing People and Products module [Only those factors identified by three (3) or more students]

Views	Food Sci. and Tech. Students	Applied Biology students
Best	<ul style="list-style-type: none"> • Knowledge of business (5) • Distance learning (3) • Tutor support/feedback (3) • Notes with examples (3) • Start to learn finance (3) • Helped with English (3) • Step-by-step process (3) • Online chat (3) • Presentation (3) 	<ul style="list-style-type: none"> • Knowledge of business (15) • Tutor support/feedback (6) • Helped with English (6) • Encourage group work (5) • Outside bioscience (4) • Developing a business idea (4)
Difficult	<ul style="list-style-type: none"> • Learning and working within the 6 weeks time frame (5) • Doing financial forecasts (5) • Difficult to learn finance by distance learning (4) 	<ul style="list-style-type: none"> • No business background (14) • Knowing what is really important in a business plan (6) • Doing financial forecasts (5) • Using English (3) • Doing all the work within the 6 weeks time frame (3)
Improve	<ul style="list-style-type: none"> • Better time management (5) • More preparation for writing a business plan (4) 	<ul style="list-style-type: none"> • Better communication and sharing of work within group (5) • Better time management (4) • More time to settle on-campus after arrival from Hong Kong (4) • More preparation for writing a business plan (4) • More reading materials (3)

Statements such as “I now have a basic concept of management” and “learning how to start a business” reinforce that the module did succeed in developing a better understanding of business processes by scientists, which is crucial if more quality science is to be transformed into quality products and services. Both student cohorts also prioritized “tutor support and feedback” and “helped with English” as the next best things. These two points were picked up in earlier discussion, and must be considered as fundamental requirements in teaching oversea students in any subject using English. The Biotechnology students differed from the Food Technology Management students in that “broadening their horizons” seemed to emerge as a key

theme for the former cohort. For example, a number of Biotechnology students highlighted that it was good to think about non-scientific subjects, and to communicate with other classmates and generate business ideas. It is believed that “broadening their horizons” needs to be emphasized in the rationale and outcomes for entrepreneurship awareness education for scientists, part of which builds on personal creativity as discussed by Morrison and Johnston (2003). The Food Technology Management students differed from the Biotechnology students in that “taking advantage of learning opportunities” seemed to emerge as a key theme for the former cohort. For example, a number of Food Technology Management students highlighted that it was good to experience distance learning for the first time and the immediate responses that online chat brings, have a set of notes with examples which could be of future use, start to understand finance although it is difficult, and have an opportunity to improve presentation skills.

“No business background” was identified as the most difficult thing by 67% of the Biotechnology students (see Table 5). This was a barrier to learning which was overcome through the commitment and peer support of the students, and their alignment by the tutor with the primary task of creating and planning a “virtual” bioscience venture. Some concerns over the understanding of enterprise principles might be expressed but given this “no business background” barrier and “negative attitude to entrepreneurship” by some of these students, the participative and process driven approach used in this module is considered an important success factor. Some justification is provided though 71% of these students saying “knowledge of business” was one of the three best things about the module. Linked with “no business background” was the difficulty expressed by 29% of the Biotechnology students in “knowing what is really important in business planning”. Students, particularly in the Food Technology Management cohort, found it difficult to learn and work within the timeframe of 6 weeks. This short timeframe is believed to be a “barrier” to developing students’ understanding of basic finance principles. This was expressed in another way by 28% of the students stating that “doing financial forecasts” was one of the three most difficult things about the module (see Table 5).

Students did not recommend fundamental changes to the design of the module (see Table 5). “Better time management” was identified as an area for improvement by 25% of the students. It is therefore desirable that the module is delivered over a longer period of time. NICENT (2003 b) has reported the launch of a new student-centred, independent learning “Entrepreneurship Awareness” module (level 2, 100 study effort hours over 12 weeks), which makes extensive use of the WebCT VLE but retains face-to-face teaching activities through three workshops. Atkinson (2003) and the Food Technology Management students in this study (see Table 4) also highlight the value placed on face-to-face teaching activities by aspiring venture creators. “More preparation for writing a business plan” was identified as an area for improvement by 22% of the students. It is therefore desirable that more attention is paid to communicating the really important things in business planning, and giving business plan examples with critiques on their strengths and weaknesses which are supported by Atkinson (2003). In addition, 24% of

the Biotechnology students highlighted the need for “better communication and sharing of work within the group”. It is therefore desirable that there is greater transparency in responsibilities within each group, and a mechanism for peer and self assessment of team work.

Conclusions

The importance of tutor involvement and “experiencing” venture creation which is reported in the entrepreneurship education literature was reinforced through this study. An enterprise and transferable skills model was shown to be effective for the development of entrepreneurial interests, knowledge and skills in Bioscience overseas students. An important strength of this model as implemented through a blended learning experience (distance and face-to-face teaching activities) within the Developing People and Products module was its ability to develop an understanding of venture creation in a sample (n=36) of Bioscience students, 39% of which had no business background and 30% of which will not consider starting a business at some stage in their career. Significantly, the BSc Hons Food Technology Management cohort was more likely to consider starting a business than the BSc Hons Biotechnology cohort (99% confidence level), which appears to relate to related career aspirations. Students prioritized “knowledge of business” as the best things associated with the module, followed by “tutor support and feedback” and “helped with English”. In contrast to the entrepreneurship education literature, this study found “working effectively as a group” to be important in supporting students’ learning which was substantiated by identification of a significant correlation (test significance value < 0.01) between “venture creation knowledge” and “peer support”. An important area for improvement in this module was identified as more time and support for learning enterprise principles, particularly finance. It is recommended that the module be run over a longer period of time, with more examples of business planning in context and more effective target driven learning through the three face-to-face teaching sessions. It is also recommended that the students in this study are tracked and asked to complete the questionnaire in 3 years time as their perceptions of what is useful and worthwhile may change once in the workplace. In addition, further research on supporting overseas Bioscience students and determining the attitudes of Bioscience students to venture creation, before and after graduation, is recommended.

Communicating author: Peter Mitchell, School of Biomedical Sciences, University of Ulster, Cromore Road, Coleraine, Co. Londonderry, BT52 1SA. *Tel:* 028 7032 3072 *Fax:* 028 7032 4965

Acknowledgements

We would like to thank Dr Pauric McGowan, Director of the Northern Ireland Centre for Entrepreneurship for his guidance in defining the entrepreneurial process. We would also like to thank Mr Domas So and Dr Any Lau, Higher Diploma Course Leaders at the Institute of Vocational Education, Hong Kong, and Ms Salina Yau, University of Ulster, Hong Kong Office for their help to communicate with the students prior to commencement of the Developing People and Products module.

References

- Atkinson, S. (2003) Thinking outside the rectangle: Enterprising thinking styles for e-learning. Paper presented at *e-learning* Seminar of the UK Science Enterprise Centres, University of Warwick, March 26th, 2003.
- Bernardi, C., Moro, D. and Poli, A. (2003) Entrepreneurship Course at University Level: a field experience. In *Proceedings of the 48th World Conference of the International Council for Small Business, Advancing Entrepreneurship and Small Business*, paper number 1, pp 1-18. Belfast, UK: ICSB.
- Department of Enterprise Trade and Investment for Northern Ireland (2002) *think | create | innovate*. Belfast, UK: DETNI
- Evans, D. and Volery, T. (2001) Online business development services for entrepreneurs: an exploratory study. *Entrepreneurship and Regional Development*, **13**, 333-350.
- Good, W. S. (2003) *Build a dream: a Canadian guide to starting a business of your own* (5th edition: higher education edition). Toronto, Canada: McGraw-Hill Ryerson Ltd.
- Hunter, R. (2003) Adapting available resources for e-learning. Paper presented at *e-learning* Seminar of the UK Science Enterprise Centres, University of Warwick, March 26th, 2003.
- Jackson, P. (2003) Ten challenges for introducing Web-supported learning to overseas students in the social sciences. *Active learning in higher education*, **4** (1), 87-106.
- Laukkanen, M. (2000) Exploring alternative approaches in high-level entrepreneurship education: creating micro-mechanism for endogenous regional growth. *Entrepreneurship and Regional Development*, **12**, 25-47.
- Menzies, T. V. (2003) 21st Century Pragmatism: Universities and Entrepreneurship Education and Development. In *Proceedings of the 48th World Conference of the International Council for Small Business, Advancing Entrepreneurship and Small Business*, paper number 10, pp 1-14. Belfast, UK: ICSB.
- Morrison, A. and Johnston, W. (2003) Personal creativity for entrepreneurship. *Active learning in higher education*, **4** (2), 145-158.
- Northern Ireland Centre for Entrepreneurship (2003a) *Profile*. <http://www.ulster.ac.uk/nicent/profile.html> Accessed November 12th, 2003
- Northern Ireland Centre for Entrepreneurship (2003b) *NICENT has launched a new innovative module*. <http://www.ulster.ac.uk/nicent/launch.html> Accessed November 12th, 2003

O'Leary, R. (2002) *Virtual Learning Environments* (Leaflet 2). LTSN Generic Centre and ALT.

Oliver, R. (1999) Exploring strategies for on-line teaching and learning. *Distance Education*, **20** (2), 240 -254.

Phillips, M., Lunsford, J., Hawkins, R.-A. and Gilmartin, K. (2000) *Tutoring Online: Using CMC to Support Learning*. Milton Keynes, UK: The Open University.

Ramius Corporation (2001) *CommunityZero* TM.

<http://www2.communityzero.com/>

Accessed July 23rd, 2003

Rius-Riu, M. (2002) *Using the WWW in Learning and Teaching* (Leaflet 1). LTSN Generic Centre and ALT.

Ryan, M., Mulholland, C. W. and Gilmore, W. S. (2000) Applications of computer-aided learning in biomedical sciences: considerations in design and evaluation. *British Journal of Biomedical Science*, **57**, 28-34.

Solomon, G. T., Duffy, S. and Tarabishy, A. (2002) The State of Entrepreneurship Education in the United States: A Nationwide Survey and Analysis. *International Journal of Entrepreneurship Education*, **1** (1), 65-86.

Trainer, G. H. (2003) Be in business: your own or someone else's. Paper presented at the *Work Related Learning Swap Shop* of LTSN Bioscience and LTSN Geography, Earth and Environmental Sciences, University of Leeds, February 26th, 2003.

Vyakarnam, S. (2002) Developing enterprise courses: What works? Paper presented at the *Training the Trainers Workshop* of The Cambridge-MIT Institute, London Business School, June 18th, 2002.