Applying research-based learning in medical education through the route of special study modules: Notes from the UK

Abstract

Involvement in research has largely been the privileged domain of academics and postgraduate students – with few examples in the literature of undergraduate students' engagement in research. In the UK, however, Special Study Modules (SSMs) feature prominently in undergraduate medical programmes. This is in response to the requirements laid down by the General Medical Council, which stated that medical students need to be trained in the methodology of research.

The purpose of this article is to describe and discuss the contextualization of research-based learning through Special Study Modules in the undergraduate medical programme at a University in the UK. Students were given support through: 1) Training and development in research methodology; 2) formative feedback on their research proposals; and 3) supervision of their research projects. The research output was a poster presentation, which constituted the summative assessment.

Students not only acquired knowledge and skills, but were also responsible for *producing* knowledge through research-based learning. The article concludes by describing the challenges and merits of applying research-based learning through the route of SSMs. Although the method for research-based learning discussed in this article is located in medical education and in the form of SSMs, it can be applied in any other discipline.

Key words: Research-based learning, Special Study Modules, medical education, generic skills, problem-solving, assessment rubric.

Introduction

Butcher, Davies and Highton (2006) suggest that higher education can be distinguished from other levels of education by the linking of teaching to creation and discovery. It could be argued that

teaching and learning are only seen as scholarly when they are linked to research, which is why there is a drive in higher education to link research with teaching and learning.

Turning to the literature for a definition of research-based learning produces some inconsistencies. For Gamarra, Ironside, de Vere, Allainguillaume and Wilkinson (2010), research-based learning extends from the initial data collection to presentation at a scientific conference. Similarly, Nicholson (2011:529) views research-based learning, as the "full cycle of research – from inception through to peer review and publication". Khlaisang (2010) describes research-based learning in e-learning within the context of higher education as also encompassing data collection and analysis.

Jiang and Roberts (2011), on the other hand, refer to research-based learning more in terms of research-led education, where the lecturer's research provides the basis for learning. Students are required to simply investigate and analyse the literature on a specific topic without going beyond that in terms of collecting, analysing and presenting the primary data. Therefore, research-based learning was seen merely as a library-based exercise. Further, Sadler (2008) claims that in the higher education literature, there are other terms related to research-based learning, such as research-led teaching, research-enhanced teaching (or learning) and research-informed learning.

From the literature it becomes apparent, therefore, that the extent of involvement of the student and the lecturer in the research process, and whether the focus is on the collection of primary and/or secondary data, would influence the definition of research-based learning. Definitions of the link between teaching and research would be useful in understanding the nature of the research task and what is expected of students. In this regard, Griffiths (2004) and Healey (2005) describe four combinations of the teaching and research nexus, which are determined by whether the focus is on the teacher, the student, the content – or on the process of research.

These combinations are: 1) Research-led teaching; 2) Research-oriented teaching; 3) Research-based learning; and 4) Research-tutored learning. In research-led teaching, students learn about research findings; and the content is influenced by the research interests of the staff. In research-oriented teaching, students learn about research processes as the subject is taught. In both of these approaches, it is the staff member who is involved in conducting research; and students are passive recipients of the research findings. Research-based teaching is designed predominantly around inquiry-based activities (Griffiths, 2004). Research-tutored learning focuses on students' writing and discussion of papers or essays (Healey, 2005).

In this article, the link between research and teaching is in line with the definition of research-based learning provided by Griffiths (2004). Here, the students are actively involved in undertaking research in an inquiry-based fashion; and they are responsible for producing knowledge.

In some disciplines, such as Medicine, Engineering and Social Work, the focus on Problem-based learning (PBL) makes the environment more conducive to research-based learning. In most disciplines, however, the linking of research with teaching and learning at undergraduate level is usually at the level of research-led teaching (Healey, 2005), with only limited accounts of research-based teaching and learning being found in the literature.

Since research-based learning is an emerging field, only a few examples could be found in the literature. Some of these are discussed here. For example, Knutson, Smith, Nichols, Wallert and Provost (2010) describe a research-based programme in Biochemistry, where students are required to design, implement and analyse their own laboratory experiments for an entire semester. These researchers found that students became more confident and skilled in important areas within the discipline. Further, Nicholson (2011) discusses an example of embedding research in a final-year undergraduate, field-based physical Geography module.

Research-based learning within this context was deemed to be rewarding and found to facilitate learners' autonomy.

There are many benefits for students if they are actively engaged in research, as further attested to in the literature. Healey and Roberts (2004) argue that students are more likely to benefit from research when they are actually *involved* in research, as is the case with inquiry-based learning (or research-based learning). Blackmore and Cousin (2003) contend that students involved in research-based learning develop more sophisticated levels of intellectual development. There is a perception that if students participate in research, they would then be more likely to have careers that involve engagement in research (Pretorius et al., 2003).

While there might be benefits accrued to students when they are involved in research, cognisance needs to be taken of the challenges they may face with this relatively novel approach to learning. According to the study undertaken by Jiang and Roberts (2011), although the majority of students indicated that research-based learning had a positive impact on their learning, 100% of students reported that research was challenging, since it placed more demands on them compared with passive learning. In the same vein, Smith and Rust (2011) argue that there are difficulties associated with combining teaching and research; and that this results in students becoming increasingly distanced from the activity of research.

In order to circumvent this challenge, and to enhance their learning experience, they advise that students should receive *greater* exposure to the intellectual and research culture of higher education (Smith and Rust, 2011:118). Gamarra et al. (2010) also agree that in the present higher education environment there is an important need to integrate research and teaching within the learning experience of students. They made this claim after having conducted a study, which focused on the participation of students in a collaborative research project between two scientific institutions.

They concluded from their study that providing students with such an opportunity can produce significant positive active learning experiences for them.

The drive to enable students to become active researchers gained momentum in the UK, when the General Medical Council published a document entitled: "Tomorrow's Doctors". The document contained plans for transforming the undergraduate medical programmes to produce doctors who would be capable of adapting to a changing information society. This would entail providing students with the opportunity to study areas that were of interest to them, and in the process, to develop scientific rigour and the discipline of research.

This research-based approach to medicine was termed: "Student Selected Components"; or it was otherwise known: as "Special Study Modules" (SSMs) (General Medical Council [GMC], 1993).

The GMC defines SSMs as "parts of the curriculum that allow students to choose what they want to study. These components may also offer flexibility concerning how, where and when such study would take place" (GMC, 2009:196). The GMC stipulates that SSMs "must be an integral part of the curriculum, enabling students to demonstrate mandatory competencies, while allowing choice in studying an area of particular interest to them" (GMC, 2009:50-51).

The purpose of SSMs is the "intellectual development of students through exploring in depth a subject of their choice".

One of the outcomes in the training of medical students is the: "Doctor as a scholar". In order to achieve this, the graduate should be able to apply scientific methods and approaches to medical research. This involves formulating research questions within the field, and designing appropriate studies to address the research questions, critically appraising the results of documented studies,

applying findings from the literature to solve clinical problems, as well as understanding ethical and governance issues in medical research (GMC, 2009:18).

In accordance with the recommendation of the GMC, universities in the UK introduced SSMs into medical programmes during the 1990s. The University of Liverpool, for example, introduced SSMs in 1996 (Fowell and Leinster, 2000); and the medical school at Leeds University adopted SSMs in 1999 (Whittle and Murdoch-Eaton, 2001). Following the example of their UK counterparts, universities in countries, such as Malaysia and Germany, have also incorporated SSMs into their medical programmes (Malik and Malik, 2004; Kiessling, Muller, Becker-Witt, Bengenau, Prinz and Schleiermacher, 2003).

In South Africa, however, there is little evidence of SSMs being applied within medical programmes.

The GMC requirement for medical students to be trained in undertaking research through SSMs may well have a direct relevance to the training of South African medical students. Arguably, they also need to be acquainted with evidence-based medicine, and cannot be exempted from acquiring research skills and producing knowledge – given the context of a changing, knowledge-based society. Transferable skills (discussed below), which are inculcated when students engage in research, would also be important for professional competence, irrespective of that part of the world in which students are being trained.

In the UK, every medical school uses a different approach in the implementation of SSMs (Jha, Duffy and Murdoch-Eaton, 2002). Therefore, depending on the context in which it is used, SSMs may involve a laboratory-based study or a survey (Fowell and Leinster, 2000), taught modules and projects (Murdoch-Eaton and Jolly, 2000), or a seminar on a chosen topic related to the integration of humanities with medical education (Keissling et al., 2003). Special Study Modules bring a multi-disciplinary and multi-professional slant to the curriculum (Harden and Davis, 1995).

In general, SSMs are intended to give students the opportunity to pursue topics of interest that are not necessarily related to the core-medical curriculum (Byrne, Lewis and Thompson, 1999), and to study such topics in greater depth (Harden and Davis, 1995). Special Study Modules can include courses on healthcare for refugees, medicine and the police, medicine in the classical world, and sports medicine (Cross, 2003). St. George's University of London runs a psychiatry and film SSM, where film is used as a tool to overcome the challenges of demonstrating psychiatric conditions in a safe and ethical manner (Akram, O'Brien, O'Neill and Latham, 2009).

At another institution, an SSM on childhood obesity involved exploring the role of the media as a social determinant of dietary patterns and sedentary behaviour (Wylie, Furmedge, Appleton, Toop and Coats, 2009).

Students' positive views regarding SSMs have been well documented. They perceive SSMs as being rewarding and invigorating (Harden and Davies, 1995), as well as relevant to their education; and they have indicated that they would certainly recommend it to others (Lewis and Innes, 2001). Once they have successfully completed the SSM, students are better prepared for postgraduate and continuing medical education (Harden and Davis, 1995), as well as the intellectual and attitudinal demands of professional life and changing circumstances (GMC, 1993).

According to Whittle and Murdoch-Eaton (2001:148), "Changes to the style of medical teaching will place a greater responsibility on individual medical students to manage their own learning; and [this] highlights the need for students to develop a good standard of transferable skills". They report on a study that was undertaken at the Medical School at Leeds University, which involved the assessment of attitudes of 206 first-year undergraduates to transferable skills. At the end of the first year of their MB ChB course, students were required to complete a questionnaire that contained questions that pertained to 27 transferable skills. These were grouped into six categories, namely: information

handling, technical and numeracy skills, IT skills, organisational skills, managing self-learning, and presentation skills. The response rate was 53% (or 107 out of 206 students).

Whittle and Murdoch-Eaton (2001) found that students in the aforementioned study demonstrated a high level of awareness of the value of transferable skills in medicine. In particular, they rated organizational and self-directed learning skills rather highly, and acknowledged the importance of presentation skills for effective communication with patients. Other skills that were acquired included information-technology skills, as well as technical and numeracy skills. In addition, such students had a high level of confidence in their own transferable skills.

The literature provides many examples of how SSMs have enabled students to develop valuable transferable skills. Jha et al. (2002) reported on a similar study, which was also conducted at the University of Leeds, where SSMs were being implemented. The aim of their study was to identify the themes pursued in each SSM project, and to look at the transferable skills developed. Fourth-year students were required to complete an evaluation form for an SSM in each of four clinical specialities. Responses from 181 students were received, and analysed, for the themes identified and for the transferable skills acquired.

The results showed that students claimed to have gained transferable skills, such as: communication skills; information-gathering skills; self-directed skills and problem-solving skills, after completing an SSM project.

Murdoch-Eaton and Jolly (2000) report on a study that was conducted at Leeds University on a third-year SSM block – with the aim of comparing the "conventional" and "external" type of project in terms of student characteristics, assessment results, supervisor evaluation, students' self-evaluation of skills and module evaluation. Students were required to complete a questionnaire in which they evaluated their own attainment of specific transferable skills, and to give their perceptions of

organisational aspects of the project. Five hundred and eight students had participated in the study. The findings indicated that the students in both groups were satisfied with the quality of supervision, and felt that they had gained valuable generic skills, such as: problem-solving skills, data analysis and critical literature-reading skills.

Most of the literature on SSMs describes the structure of SSMs somewhat briefly, with a greater focus being placed on evaluating the perceptions of students   The question may then be asked: How exactly does one implement an SSM within an undergraduate medical programme? In addressing this question, this article addresses an important gap in the literature. The primary aim of this article is to describe and discuss the implementation of an SSM at second-year level within the undergraduate medical curriculum of the Graduate Entry Programme (GEP) at St. George's University of London during the time that the author was employed there. The other aims of this article are to:

- Add to the existing literature on research-based learning and contribute to current debates in the field.
- Promote the implementation of research-based learning by providing a case-study example of how it was conducted.
- Demonstrate the application of research-based learning at an international university.

Study context

The study was conducted at St. George's University of London in the GEP programme, otherwise known as the fourth- year stream of the MBBS (Bachelor of Medicine and Bachelor of Surgery) degree. This course aims to allow graduates in any field access to study medicine (St. George's University of London, 2012).

The GEP follows a PBL curriculum, with PBL tutorials rather than traditional lectures being conducted. Students are involved in SSMs in the first, second, third and fourth year of the programme. The nature and focus of the SSMs in each year varies. This study has focused on the

SSM in year two, because this involves a literature survey, data collection and analysis, and presentation of the findings, which is in line with all research-based learning.

In the study reported in this article, the target group comprised all of the 80 undergraduate medical students (but graduates in other fields) in the second year of the GEP. The onus was on the student to select two SSM tutors (an academic staff member and/or a clinician) to supervise the SSM project. Therefore, the student: tutor ratio was 1:2.

Tutors at the rank of lecturer, senior lecturer, associate professor or professor were recruited to supervise students in their SSM research projects. These tutors were permanently employed, full-time academic staff, who were involved in teaching and research, as well as clinicians who worked in hospitals and taught part-time. Many of these tutors had prior experience of supervising students in their SSM projects.

The summative assessment of the SSM constituted the design, preparation and presentation of an academic poster. No marks were given, but instead 20 credits were received upon passing the SSM. Students who failed the SSM were not allowed to proceed to the third year of the programme.

Research methodology

A case-study method involving qualitative techniques, namely: document analysis and observational studies were applied in the research. Document analysis was conducted on: 1) The SSM handbook for students and tutors; 2) Minutes of meetings with students; 3) Minutes of meetings with staff involved in the implementation of the SSM; 4) Posters developed by the students; 5) Reflective journal entries of the author; and 6) E-mail communication with the students. Observation notes were made during lecturers presented to students, and workshops were run for staff involved in the summative assessment of posters. Observation notes were analyzed, in accordance with selected

components of the framework for observation foci, as provided by McMillan and Schumacher (2001),

the checklist for observation outlined by Spradley (1980), and the techniques described by Cohen,

Manion and Morrison (2000).

Results

The results are given in terms of the SSM method, which has been divided into the following sections:

1) The preparatory phase; 2) the research process; and 3) The summative assessment.

SSM Method

The three phases in the SSM research project are tabulated as follows (see Table 1):

Table 1: Phases and related activities in the SSM research project

Phases of project	Activities	Timelines/approximate number of hours
Preparatory phase	Introductory lecture on SSMs and explanation of assessment criteria. Issue of SSM handbooks.	2 hrs.
	Selection of tutors to supervise the research project.	2 hrs.
	Obtaining approval from the ethics committee, if necessary.	3 hrs.
	Submission of proposals to the SSM committee.	5 hrs.
	Support for students through training in SPSS; Excel; research methodology and statistical analysis.	10 hrs.
	Drop-in SSM clinics.	10 hrs.
Research process	Designing of research instruments and the collection, analysis and evaluation of data. Designing and creating a poster.	One month
Summative assessment	Submission and presentation of the poster, and oral defence.	2 days

Preparatory phase

In the preparatory phase, students were given a lecture on what the SSM project entailed, and SSM handbooks were issued. Students were informed that SSMs are both self-selected and largely self-

directed, and that they were expected to design and implement a research or audit project that included data collection. The students were free to collect the data in a variety of ways, including extraction from a pre-established database, laboratory-based work, the use of an already validated questionnaire or a questionnaire that they had developed.

If they wanted to use a newly designed questionnaire they were advised to conduct a pilot study first, in order to establish the viability of the questionnaire. Another issue that students needed to consider was the availability of the target population during the SSM period. In addition, the assessment criteria for the summative assessment of the poster, as well as the guidelines for poster production, were explained to the students.

The SSMs gave academics who would not normally supervise students in their research, an opportunity to do so. The tutors were also issued with an SSM handbook, which had been designed especially for them, in order to allow them to stay abreast of the objectives and requirements of the SSM, as well as the expectations of the tutors.

Further support for students included SSM drop-in clinics, where they could consult with a member of the SSM committee any problems they had encountered. Training in SPSS and Excel was also available. In addition, research methodology, which formed part of the medical curriculum included: lectures on the choice of sample size; the development and administration of questionnaire surveys; choice of statistical tests and data-analysis techniques; the presentation of data and statistical analysis, as well as the presentation of the research on a poster.

The outcomes of the SSMs, which were explained to the students, pertained to the process and structure of the SSMs, rather than to any specific content. These outcomes were aligned with the assessment criteria for the SSM. In terms of specific content, the students decided for themselves what they would learn, making the SSM truly learner-centred.

Rather than being offered a list of pre-determined topics, the students were expected to select their *own* topic of interest. They were then required to submit an initial brief proposal of 150 words, outlining: Their topic; the aim of the project; a short description of the study; whether or not their project would require ethical approval, and the proposed SSM tutor. Draft application forms for ethical approval and draft questionnaires would also have been submitted with the first proposal. If ethical approval needed to be sought, proof of such permission needed to accompany the second proposal.

Once the first proposal had been approved by the SSM committee, the students were requested to submit a more comprehensive second proposal, which contained the following information:

- Project title.
- Place of study.
- Aim of the study.
- Background to the study.
- Previous experience in the area of the study.
- Whether patients would be involved in the study.
- Type of sampling and number of samples.
- Data-collection methods.
- Data-analysis methods.
- Ultimate use of the data.
- A declaration signed by the SSM tutors confirming that they had agreed to supervise the project.

The students were allowed to proceed with their research projects, only once their second proposal had been approved. In some cases, students were asked to revise their proposals before being allowed to proceed with the study. Through this exercise, students developed important skills in selecting an appropriate, researchable topic, and planning for the research project.

The research process

The research process involved: a literature review; the collection, analysis and evaluation of data; and the construction of a poster. The students were given information about the SSM at the beginning of the academic year, so that they could start with preparations for their SSM project through literature searches and the submission of a research proposal. The four weeks before the end of the academic year were designated for the data collection, analysis and presentation of the findings in the form of an academic poster. The students were advised to manage their time effectively, so that the research could be completed during the allocated period.

This exercise taught them time management and organizational skills. In addition, when students submitted their research proposals, the task of the SSM coordinator who reviewed the proposal was to ensure that the research project was of a scale that would allow for completion within a one-month period. That is, the project could not be too large.

Those students, who were involved in conducting a clinical audit, used the method of document analysis to collect any information related to their topic. Those who opted to undertake empirical research applied self-administered questionnaires, interviews or observations to gather the data. Examples of topics selected by students are shown in Table 2.

Table 2: Type of study and examples of topics selected for the SSM projects

Type of study	Topic

Clinical audit	"Secondary prevention post-acute myocardial infarction: An audit of prescribing pre- and post-new General Medical Services Contract". "Audit of diabetic care in general practice".
Empirical research	"Effects of cadaveric donor type on renal transplant outcomes". "Admission into hospital of patients known to a community palliative-care team". "Psychiatric inpatients perceptions of their personal safety: How many patients feel 100% safe, 100% of the time?" "Shared care or shifted burden? Treating drug misusers in primary care".

During the research process, the role of the SSM tutor was to supervise students in the collection and analysis of the data and in the presentation of the results. Tutors were required to meet with their students at least once a week to provide continuous and formative feedback. While most tutors had had prior experience of supervising students with their research projects, some tutors with limited supervising experience had to be used, because of the labour-intensive nature of SSMs. This was an opportunity for professional development, because being an SSM tutor gave them a chance to supervise research projects, when they would otherwise not have done so.

Summative assessment

The fair and objective assessment of students becomes a problem in SSMs, due to the diversity and flexible nature of their research projects (Fowell and Leinster, 2000). To address this challenge, an assessment rubric was developed, and a criterion-referenced assessment was applied in the summative

assessment. The sections for the poster production and presentation within the rubric included: 1)

"Scientific approach"; 2) "visual presentation of the poster"; and 3) "oral presentation of the poster".

These sections were accompanied by the assessment criterion (see Table 3), for which descriptors

indicated different levels of performance in the actual assessment rubric.

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Table 3: Structure for the assessment rubric

Categories of the research output	Assessment criteria
Scientific approach	Aim of the study is linked to the literature. Contextualization of the literature. Description of data collection method. Analysis of data addresses aim of the study. Drawing of conclusions. Explanations of the limitations of the study.
Visual presentation	Adherence to guidelines for poster production. Clear illustrations. Organized display of material. Use of understandable language. Aesthetic appeal of the poster. Consistent and accurate referencing.
Oral presentation	Description of project in a logical manner. Engagement in dialogue on the project.

Although descriptors of the criteria were assessed using a 3-point scale of: "Acceptable" (if the criterion was fully met); "Cause for concern" (if the criterion was partially met); and "Unacceptable" (if the criterion was not met), a recommendation of "Excellent" could have been made if it was substantiated by a motivation.   Prior to the summative assessment period, the assessors were trained in the application of the rubric to induce objectivity and fairness.

The rubric was also useful, as it gave the students guidelines, and an indication of what they could expect in the assessment. Some of the students were keen to know what should be done, in order to obtain a grade of "Excellent".

The SSM tutor's assessment of the student's quality of participation in the SSM also formed part of the summative assessment. The quality of participation comprised several criteria: 1) The management of own learning; 2) the engagement in collegial discussions with the SSM tutors during the SSM period; 3) the response to feedback given by the tutors; 4) the display of organizational skills; 5) the meeting of required deadlines; and 6) the display of the poster for assessment.

During the summative assessment, students were given a 10-minute slot to present their submitted posters under conditions similar to those in a conference. They were required to use eight minutes for the oral presentation of the poster, and two minutes in the defence of questions from the assessors. Two assessors were responsible for examining a student, and they needed to reach consensus on the grade awarded. In cases where the independent assessors did not agree, the SSM committee reviewed the grades and moderated the marks.

Discussion

In order to ensure that patient care is evidence-based, it is imperative that medical graduates possess the skills needed to continuously update their relevant medical knowledge and the practice thereof (Hilgers and De Roos, 2007). Research-based learning through the route of SSMs, as described in this article, provided an important avenue for students to engage in self-directed, life-long learning while concomitantly contributing to the production of integrated knowledge in the field of medicine. The SSM was truly learner-centred, in that students had the responsibility of selecting their own topics, and determining the outcomes of the study, albeit under supervision.

Constructivist approaches to teaching and learning were employed in the execution of the SSMs. The students were afforded the opportunity to create their own meaning of knowledge, and their learning was scaffolded through supervision by their SSM tutors. Therefore, in the SSM model described in this article, there was a heavy reliance on the SSM tutor's ability to be able to successfully supervise research among medical students. While the model gave academics who acted as SSM tutors, an

opportunity to supervise such research, a caveat of the model was the assumption that all SSM tutors had the expertise to supervise research.

Training and development in the supervision of research should have been provided for SSM tutors, but this did not necessarily happen. A further weakness of the model was that the mandatory focus on research did not accommodate students who were not interested in undertaking and writing up research, and who would rather have spent more time in the wards attending to patients.

As with most educational innovations, SSMs are not without their logistical challenges. The SSM model discussed in this article was labour-intensive: SSM administrators were required to receive research proposals from students, as well as to handle other logistics; SSM assessors had to be recruited and trained; SSM tutors were required for the supervision of projects, and an SSM committee with an SSM co-ordinator as the academic leader was essential for the organisation of the SSM. Assembling a good team supportive of one another is key to the successful implementation of the SSM. Also, effective and regular communication – in the form of meetings and e-mail messages is important.

In addition, the SSM was time-consuming, because processing proposals, attending to email and face-to-face queries, and organising the summative assessment took time. A strategy to save time would be the use of clear assessment criteria, which would help students understand what is expected of them. This would obviate the need to give extensive formative feedback, which takes time. This author also found that blocking off scheduled time (for example a Friday afternoon) to respond to e-mail enquiries from students was more effective and less time-consuming than responding to every e-mail message immediately.

The SSM was also costly to implement. The large number of SSM assessors needed meant that additional staff had to be recruited and paid, for their role in the summative assessment. For students,

the cost of photocopying (the university sponsored each student with just ten pounds), producing the poster and transport costs incurred when undertaking the research, had to be borne by themselves. Therefore, when embarking on an SSM, it is important to plan for the cost of implementation by building that into the departmental budget.

Nevertheless, the research-based SSM model provided a valuable opportunity for undergraduate students to become involved in research. As Healey (2005) advocates, actively engaging students in research strengthens the link between research and teaching, and enhances student learning. It is the author's personal opinion that SSMs could also be a means of "transformative teaching". According to Wylie et al. (2009), students who are involved in SSM projects could play an important role in curriculum development, because they are in a better position to review and critique recent studies, and to determine best practice in the field.

Higher Education Institutions that wish to embark on an SSM could run a pilot project to optimize a model that would be conducive to best practice. A senior member of staff should act as the co-ordinator of the SSM. A well-structured SSM programme, for which time is allocated, could then be designed and implemented. The SSM model should ensure that key generic skills are addressed. Academics and students should be motivated to encompass the change towards SSMs in the medical curriculum; and they should undergo training in the implementation of SSMs.

Academic staff should be encouraged to visit universities in the UK, where SSMs are being applied. Academic staff involved in the implementation and co-ordination of SSMs in the UK could be invited to facilitate workshops for the training and development of academics at other universities.

Although the SSM model discussed in this article pertained to graduate entrants, the model could be adapted for application to those undergraduates who are not graduate entrants. There are many higher education institutions worldwide that are implementing problem-based learning, which implies that

even undergraduates (who are not graduate entrants) are required to be self-directed, independent learners. These educational qualities would hold them in good stead to make the transition towards engaging in SSMs, since this also demands that students possess self-directed learning skills.

When introducing a research-based SSM to undergraduate students (who are not graduate entrants), it would be advisable to do so among students who are beyond the first year of study. Arguably, it is at the higher levels that students would be more mature learners, and would have become acclimatised to the curriculum. Nevertheless, support should still be provided in terms of lectures and seminars on research methodology. Specifically, students should also be taught how to receive and respond to feedback on their research projects. A further priority would be the training and development of academic staff in supervising research among undergraduates.

Conclusion

Although the method for research-based learning discussed in this article is located in medical education, and is in the form of SSMs, it could be applied in any discipline.

There is a great deal of educational focus on the importance of inculcating self-directed, life-long learning skills among students. This is based on the perception of students as mere *consumers* of knowledge. In order to survive in the future, these skills, although important, will not be enough. Students will have to be *producers* of knowledge, to be able to adapt to the knowledge society of the future. Increasingly, universities would need to provide opportunities within their programmes for undergraduate students to engage meaningfully in research, as scholars.

Students' involvement in research through SSMs would enable them to cope with the challenges and complexities experienced within a changing society. They would be better positioned to access and interpret available knowledge, and to make informed decisions about professional practice, based on evidence.

References

AKRAM, A., O'Brien, A., O'Neil, A. and Latham, R. 2009. Crossing the line: Learning psychiatry at the movies. *International Review of Psychiatry* 21:267–268.

BLACKMORE, P. and Cousin, G. 2003. Linking teaching and research through research-based learning. *Educational Developments* 4:24–7.

BUTCHER, C., Davies, C. and Highton, M. 2006. *Designing Learning: From module outline to effective teaching.* New York: Routledge**.**

BYRNE, P.A., Lewis, S.E.M and Thompson, W. 1999. Special Study Modules: A student's perspective. *Medical Teacher* 21:299–301.

COHEN, L., Manion, L. & Morrison, K. 2000. *Research methods in education*, 5th ed. London: Routledgefalmer.

CROSS, P. 2003. Getting the most out of SSMs. *Student Biomedical Journal* 11:336.

FOWELL, S. and Leinster, S. 2000. Case study 1: Criterion-based assessment of Special Study Modules. *Medical Education* 34:62–65.

GAMARRA, J.G.P., Ironside, J.E., de Vere, N., Allainguillaume, J. and Wilkinson, M.J. 2010. Research-based residential fieldwork learning: Double bonus? *Bioscience Education* 16: article 6.

GENERAL MEDICAL COUNCIL (GMC). 1993. Tomorrow's Doctors. *Recommendations on undergraduate medical education.* London: General Medical Council.

GENERAL MEDICAL COUNCIL (GMC). 2009. Tomorrow's doctors: Outcomes and standards for undergraduate medical education. [http://www.gmc-uk.org/Tomorrow's-Doctors] [Date of Access: 30 July 2012].

GRIFFITHS, R. 2004. Knowledge production and the research-teaching nexus: The case of the Built-Environment disciplines. *Studies in Higher Education* 29:709-726.

HEALEY, M. 2005. Linking research and teaching: Exploring disciplinary spaces and the role of inquiry-based learning. In: Barnett, R. (ed.). *Reshaping the University: New relationships between research, scholarship and teaching.* McGraw Hill: Open University Press.

HEALEY, M. and Roberts J. (eds). 2004. *Engaging students in active learning: Case studies in geography, environment and related disciplines.* Cheltenham: Geography Discipline Network and school of Environment, University of Gloucestershire.

HARDEN, R. M. and Davis, M.H. 1995. AMEE Medical Education Guide no. 5. The core curriculum with options or Special Study Modules. *Medical Teacher* 17:125.

HILGERS, J. and De Roos, P. 2007. European-core curriculum: The students' perspective, Bristol, UK, 10 July 2006. *Medical Teacher* 29:270–275.

JHA, V., DUFFY, S. and Murdoch-Eaton, D. 2002. Development of transferable skills during short Special Study Modules: Students' self-appraisal. *Medical Teacher* 24:202–207.

JIANG, F. and Roberts, P.J. 2011. An investigation of the impact of research-led education on student learning and understandings of research. *Journal of University teaching and Learning Practice* 8(2):Article 4. [http://ro.uow.edu.au/jutlp/vol8/iss2/4.] [Date Assessed: 13 August 2012].

KHLAISANG, J. 2010. Proposed models of appropriate website and courseware for e-learning in higher education: Research-based design models. Paper presented at the E-LEARN world conference on e-learning in corporate, Government, Healthcare & Higher Education, Florida.

KIESSLING, C., Muller, T., Becker-Witt, C., Begenau, V., Prinz, J. and Schleiermacher, S. 2003. A Medical Humanities Special Study Module on principles of medical theory and practice at the Charite, Humbolt University, Berlin, Germany. *Academic Medicine* 78:1031–1035.

KNUTSON, K., Smith J., Nichols, P., Wallert, M.A. and Provost, J.J.   2010. Bringing the excitement and motivation of research to students; using inquiry and research-based learning in a year-long Biochemistry laboratory: Part 11—Research-based laboratory—A semester-long research approach using malate dehydrogenase as a research model. *Biochemistry and Molecular Biology Education* 38(5): 324-329.

LEWIS, T. and Innes, M. 2001. DIY Special Study Modules. *Student Biomedical Journal* 09:82.

MALIK, A.S. and Malik, R.H. 2004. Core curriculum and Special Study Modules at the Faculty of Medicine and Health Sciences, Universiti Malaysia Sarawak. *Education for Health* 17:292–302.

MCMILLAN, J.H. and Schumacher, S. 2001. *Research in Education: A conceptual introduction.* New York: Longman Inc.

Nicholson, D.T. 2011. Embedding research in a field-based module through peer review and assessment for learning. *Journal of Geography in Higher Education* 35(4):529-549.

MURDOCH-Eaton, D. and Jolly, B. 2000. Undergraduate projects: Do they have to be within the conventional medical environment? *Medical Education* 34:95–100.

PRETORIUS, E., Solomon, J. and Stribling, C. 2003. Medical students' attitudes toward inclusion of a research year within a diagnostic radiology residency. *Academic Radiology* 10: 77-82.

SADLER, R. 2008. Learning and Teaching Newsletter: Griffith University. Issue7. [http://www3.griffith.edu.au/03/ltn/teachtalk/teachtalk_02.php] [Date of Accessed:13 August 2012].

SMITH, P. and Rust, C. 2011. The potential of research-based learning for the creation of truly inclusive academic communities of practice. *Innovations in Education and teaching International* 48(2):115-125.

SPRADLEY, J.P. 1980. *Participant observation*. New York: Holt, Rinehart &Winston.

ST. GEORGE'S UNIVERSITY OF LONDON. [http://www.sgul.ac.uk/] [Date accessed: 10 August 2012].

THOMPSON, T.D.P. and Thompson, E.A. 2009. "In at the deep end": An intensive foundation training in homeopathy for medical students. *Homeopathy* 98:107–114.

WHITTLE, S.R. and Murdoch-Eaton, D.G. 2001. Attitudes towards transferable skills in medical undergraduates. *Medical Education* 35:148–153.

WYLIE, A., Furmedge, D.S., Appleton, A., Toop, H. and Coats, T. 2009. Medical curricula and preventing childhood obesity: Pooling the resources of medical students and primary care to inform curricula. *Education for Primary Care* 20:87–92.