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MONOGRAPH

Increasing First Year Student's Attitude and Understanding towards Biomedical Research

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Abstract
When you want to teach students academic and scientific skills, why not start in their first week at University? In a 7 day course, students in biomedical sciences go through the full process of doing research. The theme of the course is skin cancer, and students work in pairs, starting from pre-formulated research questions. A systematic literature search is the main source of information for the answers. Other educational activities range from lectures, group discussions, e-learning module to visiting a foreign laboratory by virtual meeting. The course ends with an oral presentation of the results and the presentations are marked for scientific quality. Grading is based on scientific quality of the presentation and the literature research. Following completion of this course, improvement of first year student's attitude and understanding towards biomedical research is remarkable.

Introduction
At Leiden University Medical Center (LUMC), the scientific and academic training of students is a major thread throughout the medical and biomedical curriculum.

Scientific training aims at students acquiring skills and knowledge in order to conduct scientific research, namely designing and performing experiments, analyzing the results and engaging in a scientific discourse. Discussing and gaining an appreciation of the process of conducting research improves students' attitude towards research and may foster life-long learning. Academic training fosters scholarly attitudes, aiming at critical reflection of the context of biomedical research and its applications, beyond their own research environment.[1-3]

In both the medical and biomedical curriculum at LUMC, scientific and academic training is organized in longitudinal programs, woven into block-oriented curricula. In the biomedical curriculum, this longitudinal program is called Biomedical Academic Scientific Training (BAST). It focuses on topics like literature research, critical thinking and reflection skills, ethics, humanities, society, and philosophy. The first encounter of our students with the BAST program is our 7 full-day long course at the very beginning of the first year. In this course, students get acquainted with the field of biomedical research and their curiosity in science is stimulated. Although these students have had no single lecture on biomedical content yet, they are immersed in solving a realistic scientific question on the topic of skin cancer.

The learning goals of our course are:

1. acquisition of knowledge of and insight into basic aspects of a biomedical theme (in this specific situation skin cancer)
2. discussion of the obtained knowledge and insight with fellow students
3. acquisition of and reporting on relevant valid information on a scientific research question
4. grading and documenting of information with respect to a research question and presenting the outcome to fellow students

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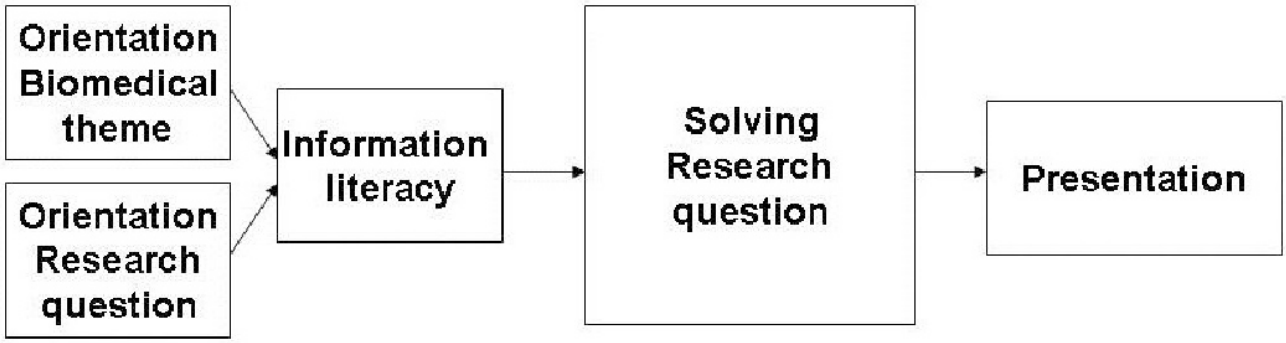

Figure 1*: Outline of the course*

To achieve the learning goals, we use several educational activities including plenary lectures and small group learning. Interactive discussions are induced by a patient presentation, by making use of clickers during the lectures and by holding a plenary Skype session. Other activities used are concept mapping, e-learning, and oral presentation.

Detailed layout of the course

Our course consists of five elements as depicted in Figure 1. All activities in the course are concentrated around a realistic research question that students have to work on and solve during the week.

Orientation on biomedical theme

The first element in the course is orientation on the biomedical topic of skin cancer. Issues related to biomedical research in this field are introduced in a plenary discussion with audience participation by means of response clickers. Discussion issues cover the entire field of conducting biomedical research, from legislation on obtaining patient material for biomedical research, storage of the material in biobanks, access to material and data, grant proposal writing, experimental set-up, publication and dissemination of research results, translation of results into the clinic or developing new research programs. From the very first moment in their curriculum, the discussion forces students to broaden their minds on research goals and how to achieve them. The session draws the basis for more specialized lectures on these topics later in the course. More specific background information on the biomedical topic of skin cancer is provided by a series of plenary lectures. This series is completed by lectures on the philosophy behind biobanks and medical registries.

Another activity to get students introduced into the world of research is a Skype meeting with a researcher from another research institute. Before contacting this researcher, his/her research field is explained to the students. Students are asked to formulate research related questions that they can ask in an online discussion with the researcher (Figure 2). This session is intended to make students realize that biomedical research is a team effort performed by collaborating researchers on a national and international level.

Figure 2*: Students and tutor taking part in a Skype meeting with a scientist from another research institute.*

The relevance of the theme is further illustrated by presenting a real patient from our clinic. This patient with metastasized melanoma skin cancer speaks about his journey as a cancer patient and his experiences with the medical field. Students are encouraged to ask questions.

Orientation on the research question

The first year of biomedical science consists of 70 students. These students will work in small groups, consisting of 14 students, who are supervised by a tutor. Seven research questions have been formulated, meaning that within each group a pair of students can work on each question. All research questions are introduced by means of a concept map discussion. At a plenary meeting, students are

randomly divided over small groups in which one of the seven research questions is introduced. All aspects that come to mind by discussing a designated topic of this specific research question are written or drawn at a huge piece of paper. After completing the concept map, one or two representatives of each concept map group present their results to their fellow students (Figure 3). After seven presentations, all students have some general understanding and impression of each of the seven research questions. This group activity allows them to make an informed choice on which of the questions they will work on for the remaining part of the course. After this selection process, pairs of students are responsible for the research outcome and dissemination of that outcome by presenting to fellow students. Knowing their research question also motivates students when they take part in the third element of our course.

Information Literacy

Information Literacy is the third element in the course. We constructed a blended learning strategy, starting with a general lecture introducing the system of systematic information search (Figure 4). Following this orientation, an e-learning module is offered to the students in the presence of a tutor to answer possible questions. The theme of the e-learning is the role of exposure to ultraviolet rays in the development of melanoma as it relates to the topic of the whole course. During the e-learning, all the steps of a systematic literature search are completed by the students. During the first step, students have to formulate a search strategy for PubMed based on their research question. A well-built patient question containing four parts: 1) Population, 2) Intervention, 3) Comparison, and 4) Outcome(s), or simply PICO, is used.[4] In the orientation phase, students get an overview of the subject and the English scientific vocabulary that is used. Internet and books are used as information sources. After the orientation phase, students perform a database search in PubMed. They experience the difference between their normal 'Google style' way of searching for information and the systematic way of searching as used in scientific research. They combine MeSH (Medical Subject Headings) terms, which are systematic subject headings added by PubMed, and free text (words expected to be used in titles and abstracts) for each component (Population, Intervention, and/or Outcome(s) of PICO). After combining these terms for one component with the conjunction 'or', students combine the separate components with the conjunction 'and'. The snowball method is used to retrieve more relevant information by checking references from websites, journal articles, and other pertinent sources. In a guided tour, students learn how to use the physical library and retrieve hardcopy books they found in the online Catalogue during the orientation phase of the e-learning.

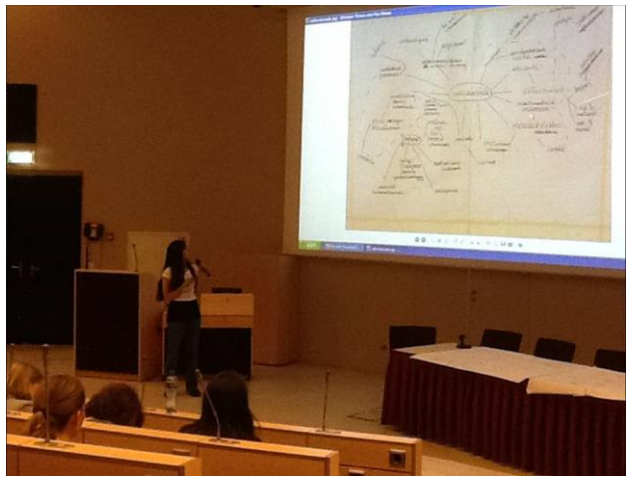

***Figure 3**: Presentation of a concept map by a student to her fellow students*

Solving the research question

The most important element in the course is increasing the students' research experience and skills by working on and subsequently finding a solution to the research question of their choice. In this part, students repeat the steps of systematic searching for their own research question. They document what they do by filling in a standardized reporting form in Microsoft Word. PubMed searches are saved in this document. In this way, the tutor can closely monitor (and finally judge) what steps are taken and if the literature search meets our quality standards.

The next day, students obtain feedback on their searches in small groups, resulting in a list of PubMed articles relevant for their research question. Subsequently, they are taught how to read and analyze a scientific article on increasing incidence rates of skin cancer.[5] Acquired skills and knowledge can be applied immediately by the students when reading the articles they have found during the search.

During the rest of the week, students work in small groups. In every group, couples working on one of the 7 different research questions are present. Students summarize the results of articles obtained by their literature search. Tutors working in the biomedical field, help them to interpret the (bio)medical information and to reach a sufficient scientific level.

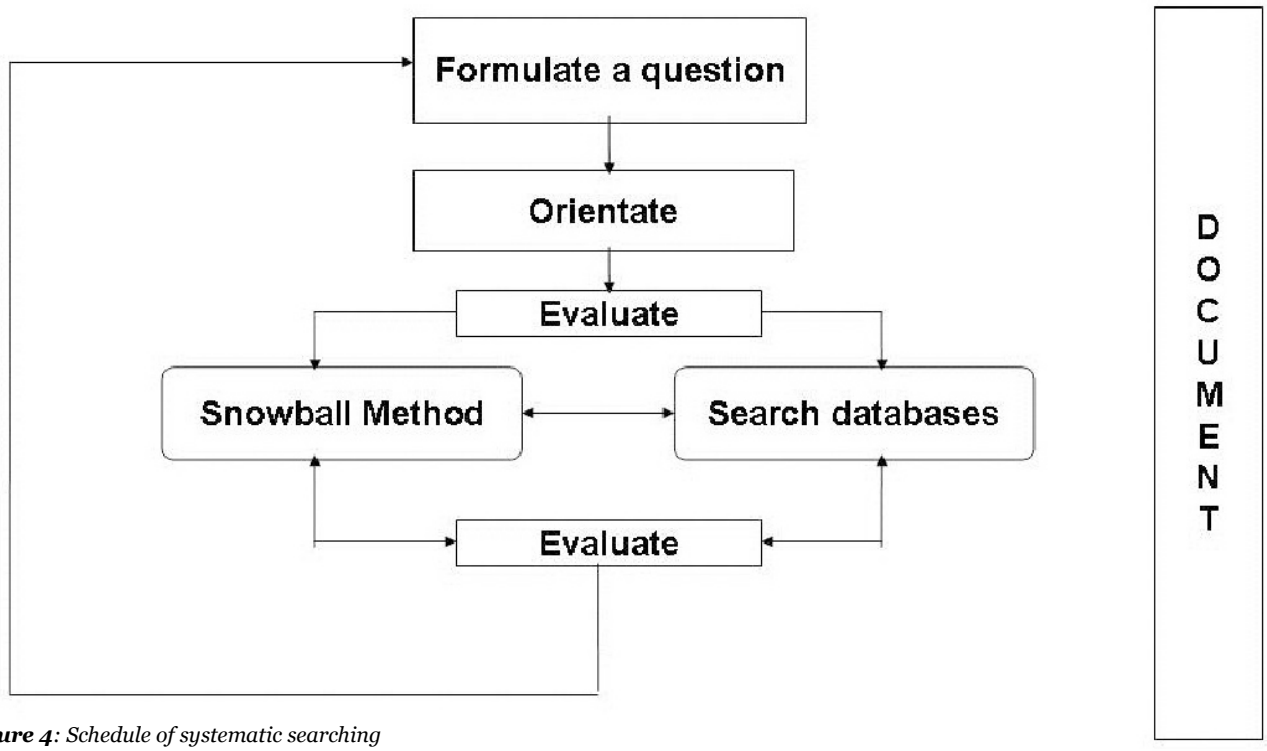

***Figure 4**: Schedule of systematic searching*

Presentation

A lecture is given on how to make an efficient scientific PowerPoint presentation. The layout of the presentation is similar to the layout of a scientific paper including an introduction, aims, results, discussion, and conclusion. Approaching the end of the course, students start preparing their presentations simulating that they are presenting for fellow researchers at a skin cancer conference. On the final day of the course, each pair of students presents the answers to their research questions by PowerPoint presentation while the other students are allowed to ask questions. Two tutors are present for grading: the group tutor and a colleague who is not familiar with the students.

Grading

The focus of the course is on the research process and its related necessary skills rather than on the requirement of specific detailed knowledge on skin cancer. For that reason an integrated assessment has been developed. Presentations are assessed independently by two tutors, one of them is the group tutor and the other is invited for judgment of the presentations only. A standardized form is used and assessment focuses both at the scientific quality of the content and working attitude during the course. Information literacy skills are assessed by means of grading the standardized reporting form the students filled in during the literature research. The final mark is a weighted average of 30% for the literature research and 70% for the presentation.

Electronic evaluation

At LUMC, all courses are systematically evaluated by the students by means of an electronic evaluation system. The evaluation consists of multiple choice questions on several aspects of the course. In open questions, students are welcomed to comment on the course. Most questions are used for all courses, but a number of specific course-related questions can be added by the course director.

Reflection and Discussion

It is very unique to submerge new first year students in research questions and having them working in a quite independent way at the very first week of the curriculum. To start with research cases is opposite to the theory of Healey, which states that learning starts with step-wise acquirement of basic knowledge, then using it in exercises, applying it to problems, and finally discussing it at the end of the 4-year curriculum.[6] However, we believe that our approach induces far more motivation in students to study and to work on their assignments.

In our course, the example of skin cancer is used to introduce students to scientific research and academic thinking as this disease impacts society and connects well to student's knowledge and interests at this early stage. The use of problem-based learning is supported by theory, although the effects in practice were not yet significant.[2] Instead of taking a patient's illness as a starting point, we raised scientific and academic attitude by research questions related to skin cancer. By engaging students in a concept map discussion, they are better informed on the context of a research question and what issues might be relevant for answering it.[7] In this way, students can make an informed choice for one of these research questions. Once committed to a particular topic, they want to search for the answer and are more motivated to take part in the Information Literacy element of the course. Placement of the information literacy element is located between the orientation elements and the Solving of the Research question for this purpose (Figure 1).

The Information Literacy competency goals in our curriculum are adapted from the Association of College and Research Libraries (ACRL) guidelines.[8] Information literacy skills are best retained when they are integrated into the curriculum.[9] In our course, the central theme of skin cancer is used to practice systematic literature research. The new skills can be applied immediately to search for literature for the research questions. To achieve optimal integration, close cooperation between faculty members and the librarian is essential. Formulating challenging research questions which are scientifically sound and suitable for literature research was a time consuming, but very rewarding experience, for librarian and faculty. This collaborative experience is often described in library research literature.[10-12] To date, motivating students was an underestimated element in building curricula, but it might have a significant positive effect on the outcomes of learning.[1] In our case, stronger engagement of the students was notable and resulted in better applying of the systematic approach of literature research by the students.

Students like working through research questions because this exercise gives them a sense of what it is like to be a scientist. The resulting presentations were of high quality, reflecting the enthusiastic involvement of the students, an experience shared by Porter et al.[3] It will help the students to stay motivated in the next courses in which they have to master a large amount of fundamental knowledge.

A suitable way of grading students' achievements in this course is grading both the presentations and the reporting form of the literature research. In this way, we don't test their knowledge on encyclopedic facts, but we can really judge their academic and scientific skills. Tennant et al. had their students presenting posters instead of PowerPoint presentations, which resulted in similar positive experiences.[13]

Conclusion

Our experience with this problem-oriented, integrated course on scientific and academic skills for first year students is very positive. Students are actively engaged in every aspect of doing their own research by answering pre-formulated, but real-time research questions. It is a pleasure to see how motivated the students are working during the course. The presentations reflect that most of them really get a strong understanding of scientific research. Designing and presenting a similar course, requires close cooperation of all teachers and tutors. With their combined efforts, the different elements of the course form one consistent whole, incorporating Information Literacy as a logical and indispensable element. This approach helps our students get off to a strong start for the rest of their studies and raises motivation for the next courses which will supply them with further basic knowledge and skills.

Key Words

Academic training, scientific training, problem-based education, information literacy

Notes on Contributors

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