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Research

Development and student evaluation of an inquiry-based elective course on drug discovery and preclinical drug development

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Abstract

Objectives: To describe the design, contents, and student evaluation of an Inquiry-Based (IB) elective course on Drug discovery and preclinical drug development in an undergraduate Pharmacy curriculum.

Methods: The course 'Development of New Drugs' is an elective course for third-year Bachelor of Pharmacy and Life Science students at Utrecht University, Department of Pharmaceutical Sciences. The course is a 7.5-credit hour course dedicated to an introduction into drug discovery and preclinical development. To stimulate, challenge, and motivate students into deep learning the course is designed according to the principles of Inquiry-Based Learning (IBL). The course consists of four group assignments and one individual assignment.

Results: The student evaluations of three consecutive years, 2008–2010, show a high appreciation of the course (7.7 ± 0.7 on a 10-point scale (90% respondents, $n = 47$)). Furthermore, students have spent on average 18.5 ± 6.0 h of the expected 20 hours per week on the course (87% respondents, $n = 45$). The students are highly motivated for the course and stimulated into critical thinking and problem solving.

Conclusion: The course is a successful way of introducing students to preclinical Drug Discovery and Development and underpins and supports the use of IBL in Pharmacy education.

Keywords: New course; Inquiry-Based learning; Drug discovery and development; Course evaluation

Introduction

Most students that enter a Bachelor of Pharmacy program have the perception of pharmacy as a clinical profession that will lead to a career in a community or hospital pharmacy.[1] According to the Workforce Report of the International Pharmaceutical Federation (2009)[2] these expectations are consistent with the proportion of actively employed pharmacists working in community (50–95%) or hospital (10–20%) pharmacies in the Netherlands and Europe. In line with the expectations of the students, and fulfilling the licensing requirements for pharmacists, the contents of most curricula for Pharmacy degrees nowadays to a large extent focus on pharmacy practice and patient care. This is also the case for the Bachelor of Pharmacy program at Utrecht University. In the years 2001–2006 a completely new curriculum was developed. Based on interviews with representatives of the work field it was decided that the pharmaceutical education in the curriculum should be mainly adapted to the increasing role of pharmacists as therapeutic advisors.[3–5] Until now undergraduate, and even graduate, programs rarely include a course on drug discovery, development, regulation, and registration.[6] As a

Institutional Review Board: The development and execution of the course, as well as the described research, was discussed by the members of the Educational Management Board of the Department of Pharmaceutical Sciences. This commission of professors and associate professors discussed the ethical issues, among other things, and they approved the research design. Following information was added in the methodology: 'The design was approved by a commission of experts in educational development'.

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consequence, students often do not have enough information to value the career opportunities within the industry.[1] Importantly, also for students who do focus on a career in the community or hospital pharmacy, knowledge of the drug discovery and development process is important. It will facilitate a better understanding of the chemical properties, efficacy and safety of drugs and the role of the pharmacist in pharmacovigilance. Hence, at Utrecht University, Department of Pharmaceutical Sciences, a new course was introduced as an elective for third-year Bachelor of Pharmacy students: 'Development of New Drugs'. The aim of this course is to introduce students to drug discovery and preclinical *in vitro* and *in vivo* drug development.

Traditionally the teaching in Pharmacy curricula is deductive and teacher-led, with transfer of knowledge from the teacher to the students. Disadvantages of this approach are that the passive transmission of information leads to surface learning and a decrease of student motivation.[7,8] A more inductive and student-led way of learning is Inquiry-Based Learning (IBL). IBL are those approaches to learning that are driven by a process of inquiry. It is a student-centered approach where the teacher formulates the task(s) and supports and facilitates the learning activities. In this way the students are stimulated to take more responsibility for their own learning process.[7] They have to draw on existing knowledge and identify their own required learning needs. IBL has been proven to encourage students to actively explore and seek new evidence. In contrast to traditional ways of teaching, IBL is more effective in stimulating a deep learning approach, analytical abilities, process skills, and critically thinking.[7,8] IBL is usually organized as collaborative work in small groups, thereby also giving the additional advantage of improving team-working and project management skills of students.[7] IBL is thus a student-centered, active approach to learning, and as such, encouraged by the Accreditation Council for Pharmacy Education (ACPE).[9] The ACPE recommends that critical thinking and problem-solving skills of pharmacy students should be developed through active learning. Educational approaches that can be used within IBL include all instructional practices that are student-led and designed to promote higher order intellectual and academic skills.[10] IBL activities can include fieldwork, case studies, individual and group projects, and research activities.[7]

With the revision of the pharmacy curriculum of the Department of Pharmaceutical Sciences in 2001–2006 it was decided to implement new educational methods such as problem- and project based learning.[3–5] The new curriculum is competency-oriented and all undergraduate courses are taught by multidisciplinary course teams. Based on the diagram of Healey[11] and Healey and Jenkins[12] the current educational activities are mainly research-led and research-oriented. Research-led ways of teaching are dominated by faculty research interests and information transmission by the teacher. In a more research-oriented way of teaching the students not only learn the necessary knowledge, but there is also an emphasis on the process by which the knowledge is acquired.[11,12] To further stimulate deep learning and critical thinking in the new course, it was decided to take an extra step and use a research-based design. Within a research-based design the students will be stimulated to learn as a researcher by inquiry-based activities, and the distance between teacher and student are minimized.[12] In the new IBL-based course the students mainly work in small teams on group projects, but they also perform an individual assignment. There are some supportive activities, like lectures and workshops. The course objectives with their specific abilities and competencies are listed in Table 1. The design and evaluation of the course was approved by a commission of experts in educational development.

Table 1
Course objectives of the 'Development of New Drugs' course. Bachelor of Pharmacy, Department of Pharmaceutical Sciences, Utrecht University

Course objectives	Abilities and competencies
1. The student is able to distinguish the first three phases within the development of a new drug (Drug Discovery, *In Vitro*, and *In Vivo* Development), describe the most important elements of the different phases, and explain their function within drug development.	Scientific comprehension
2. The student is able to design a *Study Protocol* for the preclinical research of a new drug.	Integrative competence
3. The student is able to critically evaluate the development of an existing drug that is withdrawn from the marked, and write a research proposal for preclinical and/or clinical research to put the drug 'back on the market'.	Critical thinking and decision making abilities
4. The student is able to interpret data from preclinical research in view of the requirements to start clinical research.	Scientific comprehension
5. The student can perform systematic literature research in the area of drug discovery and preclinical research: find, select, critically evaluate and analyze literature sources and information relevant to an identified problem.	Competency
6. The student is able to describe the ethical aspects of preclinical research and critically judge their value.	Critical thinking and decision making abilities