SEMESTER PROJECTS IN MEDICAL BIOPHYSICS PROMOTE ACTIVE LEARNING

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Abstract

Project learning is dynamic pedagogic approach in which students study scientific problems individually and simultaneously acquire and develop cross-curriculum skills and competences while elaborating projects. A specific model of project learning is applied at the Comenius University Faculty of Medicine in Bratislava. Semester projects in medical biophysics processed by 1st year students of General Medicine and Dentistry represent a compulsory form of teaching. Content analysis of them reflected widespread using of modern diagnostic and therapeutic methods based on physical/biophysical principles in medical practice today.

Keywords: medical biophysics, project-based learning, semester projects.

1 INTRODUCTION

The main task of teaching medical biophysics is to prepare students to understand physical laws and principles that are applied in medicine. Students get knowledge on basic physical principles of methods and devices using in diagnostics and therapy and safety problems related with them. It can be applied and improved in other medical sciences, e.g. physiology, pathophysiology, internal medicine, neurology, dermatovenerology, ophthalmology, otorhinolaryngology, internal medicine, pneumology and phthisiology and other related subjects that use methods and devices based on physical principles. In the same time the training of working with modern computer-based devices that nowadays are an inevitable part of basic equipment of any specialized medical workplace is important. [1]

Teachers of medical biophysics at Comenius University Faculty of Medicine (CU FM) in Bratislava continuously pay attention to updating syllabus of medical biophysics in accordance with the progress of science and the needs of medical practice. On the contrary, it is still necessary to explain and argue the medical community, management of faculty and students about significance of physical knowledge for both medical students and medical professionals.

A specific project-based learning model in medical biophysics is applied at the CU FM in Bratislava in order to acquaint students with the physical principles of the modern diagnostic and therapeutic methods, medical technique and devices. Semester projects processed by 1st students of General Medicine and Dentistry are compulsory form of teaching and their acceptance by teacher represents significant condition of successful completion of practical training. [3]

Based on this fact it was also assumed that physical/biophysical aspects should be described in all types of their written works, e.g. student’s scientific work, diploma thesis. Confirmation of this hypothesis could help us to underline the important role of physically oriented teaching subjects as supporting subjects in medical curriculum.

The individual stages of continual work of students under teacher’s supervision (preparation, realization, finalization) were described in previous work [2].
Table 1. Key phases of semester project creation

<table>
<thead>
<tr>
<th>Preparation</th>
<th>Realization</th>
<th>Finalization</th>
</tr>
</thead>
<tbody>
<tr>
<td>topic proposal and confirmation</td>
<td>main text structure preparation</td>
<td>Submission of the final version:</td>
</tr>
<tr>
<td>basic study literature search</td>
<td>titles of chapters, subchapters, parts suggestion</td>
<td>writing of the final version</td>
</tr>
<tr>
<td>title of the project formulation</td>
<td>working version processing</td>
<td>final text and graphical corrections</td>
</tr>
<tr>
<td>aim formulation</td>
<td>consultations with pedagogue</td>
<td>printing and binding of the work</td>
</tr>
<tr>
<td>consultations with pedagogue</td>
<td>abstract creation</td>
<td>Defence of the work: preparation for the defence</td>
</tr>
<tr>
<td>abstract creation</td>
<td>detailed literature search and collection of corresponding literature</td>
<td>defence</td>
</tr>
<tr>
<td>study literature sources and fixate them as references</td>
<td>processing of theoretical part and it submission</td>
<td></td>
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<tr>
<td>preliminary consultation</td>
<td></td>
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<tr>
<td>acceptance by pedagogue</td>
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</tbody>
</table>

Table 2. The roles of teacher & student in individual phases of project teaching and learning

<table>
<thead>
<tr>
<th>Preparation (problem identification, aims formulation, planning)</th>
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<th>Teacher work</th>
<th>Student work</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Initiates the idea of the project. Explains the purpose of the project approach and motivates the student. Helps in determining the objective of the project. Supervises the work of student. Offers ideas and suggestions. Active supervises the work of student.</td>
<td>Discuss the project topic with the teacher and if necessary receive additional information. Formulate the tasks of the project and procedure. Select and justify criteria for success in the project.</td>
</tr>
<tr>
<td>Realization</td>
<td>Realization</td>
<td>Observes, advises, indirectly controls the work of student.</td>
<td>The tasks solve in the suitable stages.</td>
</tr>
<tr>
<td>Finalization (conclusions, completion, presentation, reflection)</td>
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<td>Supervises, supports, listens, asks appropriate questions in the role of ordinary participant. If necessary, regulates the analysis procedure. Evaluates the efforts of student, quality of final report, creativity, quality of used resources, the possibility of continuing the project.</td>
<td>Carry out research, project work, analysis of information. Complete the project. Public presentation of the project, its collective analysis and evaluation.</td>
</tr>
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</table>

2 METHODOLOGY

Topics of semester projects were oriented on applications of physics and medical physics in medicine, interactions of physical factors with living organism (patients and health professionals), medical devices and implements based on the physical principle and corresponding safety standards and safety rules.

Student identify the topics of the project at the beginning of 1st semester after brief inquiry of available study and scientific literature, possibly internet information sources and work on them with timetable agreed by the teacher. Final stage of work involves both the presentation in front of student’s auditorium followed by discussion and finally submission it in written form.

Inevitable items of project are: description of physical principle of diagnostic or therapeutic method, appropriate technique and devices, fixed structure of text, references.

The content analysis of 291 semester projects (acad. years 2011/2012 – 2016/2017) was undertaken with the following aim: to summarize the wide spectrum of physical applications in medical diagnostic and therapeutic methods, safety problems related to physical principles of medical equipment, to confirm usefulness of project-based learning in medical biophysics. [4]
3 RESULTS

Totally 291 semester projects in the time interval 2011/2012–2016/2017 were elaborated by first-year medical students. Projects were divided into 2 groups (diagnostic, therapeutic methods) and 8 main biophysical topics (OP–optics, BE–bioenergetics, BM–biomechanics, AC–acoustics, BS–biosignals, RA–radioactivity, TP–transport processes, MM–modern diagnostic/therapeutic methods).

Content analysis of semester projects showed the most frequent topics: biomechanics 14.8%, radioactivity 15.5%, optics and biophysics of vision 18.9%, biosignals 26.8% and modern diagnostic/therapeutic methods (MM) 25.8% (physical principles of radiodiagnostic, ultrasonic, thermographic devices, magnetic resonance imaging, positron emission tomography, laser, osteodensitometry). Increasing tendency was observed in percentage of semester projects describing modern technologies in medicine comparing to the past. (Figure 1.)

![Figure 1. Percentage of semester projects focused on given field of medical biophysics (2011-2017). Legend: OP (optics), BE (bioenergetics), BM (biomechanics), AK (acoustics), BS (biosignals), RA (radioactivity), TP (transport processes), MM (modern D/T methods)](image)

Division into diagnostic and therapeutic methods showed higher representation of topic with orientation on diagnostic applications of medical biophysics (59.5% of them belonged to diagnostic applications and 40.5% described applications of medical biophysics in therapy). (Figure 2.)

![Figure 2. Percentage of semester projects focused on diagnostic or therapeutic methods based on given physical/biophysical principle. Legend: OP (optics), BE (bioenergetics), BM (biomechanics), AC (acoustics), BS (biosignals), RA (radioactivity), TP (transport processes), MM (modern D/T methods)](image)
A database of semester projects containing a wide spectrum of partial physical topics connected with medical applications reflecting actual needs of medical practice was created.

There were observed also some problems by semester projects processing. Skills of 1st year medical students to process the semester projects are not yet sufficient: long, uninformative text, missing structure, vague or missing conclusion. The presentation is often limited to reading text only and students auditory is not sufficiently prepared to discussion. Sometimes students submit previous copies of projects and the same topics are repeatedly presented without the knowledge promotion. This phenomenon is enhanced by new possibilities offered by internet, today.

Nevertheless our analysis has shown:

- a wide spectrum of partial physical and biophysical topics connected with medical applications reflecting actual needs of medical practice;
- low frequent/difficult topics of semester projects should motivate teachers to pay more attention to them in the teaching process.

Results of research correspond with our previous findings, weaknesses and importance of project learning were confirmed. [3, 4]

4 CONCLUSIONS

Based on obtained results we have confirmed the relevance of project-based learning in medical biophysics. It facilitates cognitive and other key competencies developed by physically oriented teaching subjects and supports both individual and team study activities. It represents an effective teaching tool that is positively evaluated by students. We also believe that project-based learning represents important motivating factor.

In the process of project-based learning students obtain certain abilities:

- thinking about a topic/problem, seeking and formulate a problem and finding a answer,
- working with professional literature and information, bibliographic standards,
- using scientific expressions in writing,
- structuring and developing thinking operations (analysis, synthesis, comparison),
- speaking in front of professional audience,
- visualizing main ideas using appropriate technical means,
- accepting criticism and critically comment to other works,
- evaluation, self-evaluation and self-reflection.

Frequent description of physical aspects and applications in medical student’s semester projects reflects widespread using of modern diagnostic and therapeutic methods based on physical/biophysical principles in medical practice today and thus our assumption was confirmed.

It was also showed the key role of teaching subjects medical physics and biophysics in medical curriculum and their close relationship with another medical specialties.

In the same time we obtained useful feedback for modification and innovation of physically oriented teaching subjects in medical study. Results of our analysis represent the base for innovation and updating of lectures and practical trainings on medical biophysics according actual needs of health–care practice.

ACKNOWLEDGEMENTS

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