

Course: Membrane potential

Learning Outcomes

Students will be able to:

1. understand the importance of establishing and maintaining the potential of the cell membranes through integration of the knowledge from physics, chemistry and biology;
2. distinguish the importance and role of different types of ion channels in establishing the membrane potential and generation and conduction of impulses along the cell membranes;
3. understand and explain the way how excitable cells communicate with each other by transmitting electrical impulses from one to the other excitable cells;
4. use the acquired knowledge for recognizing and understanding the clinical manifestations of the disease (clinical symptoms) caused by disturbances of excitation and conduction of the electrical impulses along the cell membrane of the excitable cells (as clinical models were used: Myasthenia gravis, demyelinating diseases (MS) and epilepsy);
5. solve math problems as a team, to learn how to express conclusions in short and simple way by using arguments and objective indicators.

Content

The course is a small elective course offered six years ago to the students of the first year of Medical school. Five year ago the course was switched from the classical to the blended teaching which allowed us to introduce many changes in the organization of the course. Learning become more flexible in time and space, adapted to different levels of knowledge and different learning styles (listening, viewing, reading). Introduced changes which included a variety of interactive e-contents such as multimedia, self-assessment, forums, interactive texts, animations and simulations facilitated understanding of the content and qualitatively increase the level of acquired knowledge. By fostering different e-learning activities we encouraged students to discover how chemical and electrical gradients across the membrane were established and maintained.

The course is designed to use hybrid e-learning approach which alleviate students to improve their understanding the mechanisms of establishing and maintaining the membrane potential, generating action potential (impulses or signals), propagating of the impulses along the neurons and muscles, recognizing the mechanisms that stays behind the clinical symptoms caused by disturbances of the neural impulses propagation. Additionally, by improving acquired theoretical knowledge we wanted to increase understanding of the clinical manifestations (symptoms) of diseases caused by disorders of excitation and conduction of impulses along the cell membrane. E-learning approach offered us a new and innovative approach for presenting the membrane potential knowledge. Through multimedia and interactive computer simulations we enhanced student's interest and involvement in using new technologies in the learning process that



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ultimately lead to overall raise in the final score of the tests.

For the course purposes we have created an interactive computer simulation program, named “PROSIG”, for studying physiological functions that generate membrane potential. This membrane simulations program allows students to conduct numerous simulations in electrophysiology. Such approach allows students to predict outcomes of changing variables before being given the solution by the program. This develops student's critical thinking and stresses understanding of the subject. In order to keep students motivated and active through the whole course we redesigned our lessons (topics) in a way that students are pushed to use LMS materials all the time; before coming to the lecture/practical room, during the lectures or exercises and after the class.

This course can be adaptable to either an animal/human physiology course, or an introductory course on physics for life sciences.

Teaching

Elective subject is an example of hybrid learning in which the classical form of teaching complements online teaching and learning. For on line teaching we used our own LMS (based on Moodle software platform) modified and customized to fit our needs. For the seminars and the practical lessons of the course we used an interactive computer simulation software package (PROSIG).

Within the course we have used different activities:

- Forums – were used for several different purposes: (i) communication with and between students (ii) discussion forums about the topics which students found that need additional explanation (ii) moderated discussion forums which were used for developing active discussion between students (ii) forums for questions (Q/A) which was used to test new adopted knowledge of the students within basic topics.
- Tests - online self-assessment MCQ tests covering each topic. The purpose was to allow students to check their understanding and newly adopted knowledge.
- Educational games - were generated from MCQ tests and offered to students in addition to MCQ tests. The goal was to additionally motivate students to test their knowledge through games.
- Simulations – were used wherever we could to alleviate students to understand the mechanisms that lie behind a particular process
- Interactive e-texts (html) – we have used html to enrich texts with animations for easier understanding and learning of selected topics. In addition, e-texts were used as interactive tutorials for explaining how to perform interactive simulation exercises (how to use PROSIG’s modules).
- Video – we used multimedia (e-lectures and video presentations) for different purposes: (i) an introductory video on the beginning of each topic we used to explain students what are the key

segments of each topic and to emphasize the connections between new information and the ones from previous topics; (ii) short thematic e-lectures (up to 20 min) were used to explain students the most important part of each topic; (iii) clinical video to present students the important clinical symptoms of selected diseases and how to take physical status and anamnesis; and (iv) selected video presentations (found on YouTube) covering different topics.

- Animation – were used as standalone or included in the e-texts to facilitate understanding of selected processes and mechanisms
- PPT presentations, covering thematic e-lectures, presented as pdf.

Evaluation

During course we used several different assessment methods such as diagnostic, formative, summative, dynamic and synoptic assessments.

The combinations of different assessments were used for each topic (lesson) within the course. At beginning of each lesson the diagnostic assessment was performed. During each topic seminar or practical we used formative assessments to check whether students understand different topics and can accomplish learning outcomes for each topic. After each lesson we used formative and summative assessments to check students understanding of previously completed topic (lesson). Dynamic assessments were used along with using our interactive computer simulation program “PROSIG”. Summative assessment was also set as the thread that runs through the entire course (self-testing by MCQ).

Using these different assessment methods improved the level of adopted learning outcomes and success. In fact, before the introduction of blended teaching the student’s performance at the final colloquium was below 40%, while after its introduction, the performance success raised along with improving the course by new e-content. Current performance success is 100%.

TALOE specific information

- a) Identify what was the purpose of the assessment: diagnostic, formative, summative (**Selection Criteria 2**). If different methods/practice have different purposes, please discriminate

Our assessments had:

- i. *diagnostic purpose* – it provided us with information about each student’s prior knowledge at beginning of each lesson (topic). Knowing students’ strengths and weaknesses allowed us to plan and organize the panel discussion about the topic of the each chapter.
- ii. *formative assessment* - was performed through moderated discussions within the classroom, occasionally through educational games which are typically embedded within each lessons and by simple interactive simulations that are designed to develop logical thinking and reasoning. It provided us the feedback how students accept and understand different topics. We used it to determine which topic has to be addressed to students in more details.

- iii. *summative assessment* – included interactive different self-assessment tests (or educational games) and the “forum’s questions” that measured their understanding of different topics. It also included moderated asynchronous discussion forums in which students were encouraged to debate about just completed a thematic unit, to comment, correct and/or complement other statements and opinions. Online self assessment tests and questions were used for testing student’s mastery of a subject.
- iv. *synoptic assessment* – included modules of our interactive computer simulation program “PROSIG” where each module gave students the base for understanding the following module within the program. Combining the elements of their acquired knowledge from previous modules allowed students to better and easier understand the following topics or subject areas.
- v. *dynamic assessment* – was used within the clinical part of the course where student were given patients with “unknown” diseases that have to be discovered (diagnosed) by recognizing typical symptoms. In this assessment we tested student’s ability to integrate and apply their theoretical knowledge and understanding of the basic membrane potential mechanisms that stays behind different symptoms.
 - b) For each assessment practice identified in 5. please describe what was the learning outcome (from 2.) that was intended to be assessed. (**Selection Criteria 1**)
 - a. with diagnostic assessments we assessed a student’s prior knowledge from physics, chemistry and biology courses which lead us to adjust our teaching approach for alleviating their understanding of the membrane potential
 - b. with formative assessments we tested student’s understanding of different mechanisms that stays behind establishing and maintaining the cell membrane, generation of action potential and conduction of the impulses along the excitable tissues;
 - c. combination of different assessment models were continuously to allow students to distinguish better and easier the importance and role of different types of ion channels involved in the membrane potential regulation and to understand and explain the way how excitable cells communicate with each other;
 - d. with synaptic assessment supported by other assessments we tested the ability of students to use the knowledge acquired during course to recognize and understand the clinical manifestations (clinical symptoms) of selected diseases.
 - c) Please identify and describe what were the criteria used to mark the results of each e-assessment practice (**Selection Criteria 3/8**)
 - a. the criteria were teacher’s judgement of the quality of the student’s discussions, its activity and the quality of the practical performance
 - b. in the case of the MCQ test the results were analyzed by using standard algorithms

d) Please identify who were the assessors: single teacher, multiple teachers, peers, self.
(Selection Criteria 4)

- multiple teachers for moderated discussions and forum's questions
- self – self-assessment tests

e) Please describe what type of skills and competences were intended to be assessed by each method/practice **(Selection Criteria 5)**

The goals we wanted to achieve by implementing different methods:

- raise the quality of teaching and allow students :
- to use skills and habits acquired in traditional teaching in e-learning ,
- flexibility in learning (appropriate personal way of learning), eliminating time and space limitations in access to learning materials
- encouraging students for independent work and teamwork and to encourage their critical contemplation and reasoning (constructivist approach) :
- solving of problems either individually or as a team
- encouraging active participation in the discussions (moderated discussion)
- encouraging individual and team work in contact with patients (presentation and the presentation of the disease);
- encouraging independent Internet search of medical data (to develop the habit of using the Internet in their daily work - learning);
- integrate and achieve better communication and interaction (student/student; student/teacher);
- adapt teaching to different styles of learning by introducing the various forms of multimedia content (reading, listening , writing and interactivity);

f) Starting from each learning outcome identified in 2., please identify which e-assessment methods/practices were used to evaluate the real achievement **(Selection Criteria 6)**

a. summative and synaptic assessment

g) Please describe how the learning outcomes identified in 2., the teaching practices described in 4. and the e-assessment strategies described in 5. are connected and promote the autonomy of the learner **(Selection Criteria 7)**.

a. all these approaches were complementary to each other. They are narrowly connected and supplemented each other. We adjusted our teaching practices and e-assessments to ensure student's ability to accomplish learning outcomes.