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Procedia Social and Behavioral Sciences 15 (2011) 2837–2842

Procedia Social and Behavioral Sciences

WCES-2011

Applying appropriates methods for teaching cell biology

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Abstract

Cell biology is an important basic subject of modern life sciences, consisting of fundamental life activities of the cell at the microscopic, sub microscopic and molecular levels. The cell is the basic unit of living things, with all of the activities of life taking place in the cell and with is eases also due to abnormal changes of cells.
With the current framework of teaching quality reform in higher education, this paper will review the current curriculum of a cell biology course and the ways in which it has been taught in the "Goce Delcev" University, Faculty of Natural and Technical Sciences, Biology studies, Stip, R. Macedonia. Reasons for introducing new teaching methodologies to improve student-centred learning and self-directed learning will be discussed and three possible approaches which are considered more suitable for the large classes of first year students in cell biology will be considered: case study, team work and concept. The proposal will also make a case for the urgent development of an online student-centred learning environment, including possible activities that would be included in the course. A combination of multiple teaching approaches is necessary for changing students learning from surface learning to deep learning, passive learning to active learning, over-dependent learning to independent learning, and developing students in the 'generic skills' of a scientist and the skills for 'lifelong' learning including problem solving skills, communication skills, and cooperative skill.

Keywords: cell biology, student, learning, skills for lifelong learning.

Introduction

Successful learning in the field of natural sciences is closely related to the methods used by teachers and students. In an era of rapid increase of information the entire educational paradigm is changing constantly and this is due to the continuous social and technological changes. Many problems associated with successful teaching are reviewed: students working in small groups, debating, carefully learning, competition and cooperation, concept of construction, logic learning, project work, problem solving, presentations, motivations, and evaluating teachers. The role of teachers is to organize, manage, lead, assist and support the cognitive activities of students by means questioning. The student is at the centre of the educational process. It is not enough for the teacher to know much, to be able to explain in a simple and interesting way and has his/her own charisma. He/she should facilitate and direct learning through stimulating students to ask questions, helping them to accept challenges and disagreements, to discuss the contradictions, to think critically and offer creative solutions. It is very important for students to overcome the dependence on the teachers by developing their own styles of successful learning and skills for

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1877–0428 © 2011 Published by Elsevier Ltd.
doi:10.1016/j.sbspro.2011.04.199

objective and real self-evaluation. It will help them to take responsibility for their education and personal development and to avoid shifting the blame for their failures on someone else.

With the current framework of teaching quality reform in higher education, this paper will review the current curriculum of a cell biology course and the ways in which it has been taught in the "Goce Delcev" University, Faculty of Natural and Technical Sciences, Biology studies, Stip, R. Macedonia. Reasons for introducing new teaching methodologies to improve student-centred learning and self-directed learning will be discussed and three possible approaches which are considered more suitable for the large classes of first year students in cell biology will be considered: case study, team work and concept. The proposal will also make a case for the urgent development of an online student-centred learning environment, including possible activities that would be included in the course. A combination of multiple teaching approaches is necessary for changing students learning from surface learning to deep learning, passive learning to active learning, over-dependent learning to independent learning, and developing students in the 'generic skills' of a scientist and the skills for 'lifelong' learning including problem solving skills, communication skills, and cooperative skill.

1. Successful learning

The problem of successful learning is at the heart of many contemporary studies that are concerned with the development of abilities (Bandura & Schunk, 1981), observing the dimensions of learning (Brown, 1995), developing seven intelligences (Gardner, 1987), and teaching with the five dimensions of learning (interactive teaching methods, 1998). According to R. Marcano, five types of thinking, called the five dimensions of learning, are essential for successful learning (Marzano, 1997). That is what is essential for differentiating the learning process from its results and seeing the close connection between them.

Learning as a process means students' making conscious efforts to achieve their personal educational needs, interests and goals in accordance with social conditions for effective adaptation and integration in social life, and in accordance with the current state of science and culture. It involves "processes of acquiring knowledge and skills through practice, teaching or information. Learning by doing is recommended nowadays and is defined as "the process of acquiring understanding, knowledge, skills and attitudes through practical and applied activities." It is the process of becoming competent.

Learning as a result is represented with the expected results, obtained by the student, which can be the basis and means for further learning. "Knowledge changes knowledge." Knowledge should be used with the meaning of decision making, problem solving, goals, experimental testing, investigation and analysis of the system. Effective learning is assessed by its results in relation to the objectives.

Education in the modern world is not limited to a certain period of human life but is a lifelong process. It is "the beating heart of society," a bridge between past, present and future and its meaning becomes deeper and deeper with time. People need to return to learning so as to cope with new situations arising in their personal and working life. This need is very obvious and is becoming increasingly stronger. The only means to achieve this that everyone learns how to learn. For this purpose, it is necessary to stick to the four pillars: learning to live together, learning for knowledge, learning for actinag, and learning to be" (Delors, 1996).

For the life in the twenty-first century, new personal characteristics are needed - memory, physical abilities, aesthetic feelings, communication skills, and charisma of the leader. Knowledge is dynamic and constantly changing from one state into another, which is what has to be acquired, restored and used in life.

Today's world of expanding information technology and collaborative scientific research demands that students be able to communicate across disciplines and cultures. As instructors, we need to help our students learn how to apply the scientific process, and weave it into a useable fabric with other disciplinary approaches.

Cell biology is an important basic subject of modern life sciences, consisting of fundamental life activities of the cell at the microscopic, sub microscopic and molecular levels. The cell is the basic unit of living things, with all of the activities of life taking place in the cell and with diseases also due to abnormal changes of cells. Thus, cell biology is a basic course for the first year students in the The"Goce Delcev" University, Faculty of Natural and Technical Sciences, Biology studies. The course focuses on the function at a cellular level and favours the molecular perspective. Topics in the course include two main aspects: one is structure and function of the cell and its organelles, the other is the important activities of the cell and their regulating mechanism, including metabolism, growth and reproduction, cell cycle, cell division, differentiation, cell aging and cell death, apoptosis, signal

transmission, evolution, and embryonic development. With the more recent developments in molecular biology, numerous molecular concepts and techniques are introduced into cell biology, so that it becomes difficult to cover all the content.

2. Current teaching approaches

Cell biology is currently taught with lectures and laboratory classes. There are 24 hours of lectures and 24 hours of laboratory classes. Students are separate in 3 groups in each group with 20 students.

2.1. Lectures

The lecture is the main teaching approach in the course. The lecture gives the students a comprehensive introduction to the main knowledge of cell biology. Although lecturers have tried different delivery methods, including multimedia, in their teaching, to stimulate student's interest in the course, and motivate them, the format is teacher-centred with passive learning taking place.

2.2 Laboratory class

The major function of the practical course is to teach students many of the techniques used in cell biology and the contents of the practical course are related to the lectures so as to enhance the student's understanding and appreciation of the theoretical component of the course. In the practical sessions, teaching staff usually begin each session with a brief introduction to the contents. Students work on the practical materials individually or in small groups, then write the practical report and think about some questions which is handed in for marking. The teaching staff is responsible for giving students feedback on their reports and giving an explanation of some questions.

Usually we have assessment at the end of the semester, with 10% from the practical component. The examination paper has the following format: filling in the blanks; multiple choice questions; and short answer questions.

2.3. Need for better communication between students and teachers

Less communication between students and teachers leads to less feedback and understanding of each other, especially for large classes of first year students. Most of the students are too shy to ask questions in the class, and even after the class there are few students who will ask questions. It is difficult for the teachers to get to know the students very well and to find out how they are doing.

3. What should we do in the future?

We have been introduced to a number of theories of learning and ways in which we can teach science to encourage the development of deep learning strategies in our students. Contemporary teaching approaches in the sciences currently focus on student-centred activities, and how we can encourage students to develop lifelong learning skills. This is especially important in science with the current 'information explosion'.

The purpose of teaching is not to import content knowledge only, but to encourage the development of generic skills of a student (e.g. scientific writing, communication, computing, problem solving and experimental design, data handling skills and lifelong learning skills). Teachers need to reconsider what they will teach and must also understand how students learn. Encouraging a student-centred learning approach and helping students to develop their generic skills are urgent tasks for our teachers in Macedonia.

4. Combination of multiple teaching strategies

For teaching our course, I do not believe there is a single teaching method suitable. The methods will depend on the characteristics and content of the course. We should combine multiple methods of teaching together, using them appropriately according to the actual situation. At present, we should retain the traditional teaching form – the lecture. Probably the most useful teaching and learning strategies that could be introduced into the lecture would be the use of case study scenarios and concept mapping. Activities such as teamwork, including poster preparation and presentation, are better introduced into the practical classes.

4.1. Applications of team work

It is well known that having students work in small peer groups, is one of the better ways to teach science (Webb 1989; Webb and Palincsar 1996) and this includes teaching science via case studies! The use of peer group

learning scenarios helps to overcome any initial student reticence, fosters the development of good communication skills, and promotes positive social interactions within the peer group Cooperative learning may occur in or out of class. In-class exercises may involve answering or generating questions, explaining observations, working through derivations, solving problems, summarizing lecture material, troubleshooting, and brainstorming. Out-of-class activities include carrying out experiments or research studies, completing problem sets or design projects, writing reports, and preparing class presentations. (Felder and Brent 1994)

4.2. Use of case studies

The use of case study scenarios is a very appropriate teaching method for the sciences which have been employed in western higher education for many years (Christensen and Hansen 1987; Barrows and Tamblyn 1980; McNair and Hersum 1954; Barrows 1986). Case studies need to be real or imaginary stories dealing with real live situations so that the students can immediately relate to the 'story'. Case studies serve to illustrate facts, general principles and good practices. One of the values of the case study is to show great scientists in action. It is not so much to teach the content of science but to teach how the process of science works and its limitations and to develop higher-order skills of learning. Case studies are extraordinarily flexible as a teaching tool. The use of a good case gives a teacher an immediate advantage. It is easier to hold a student's attention. Depending upon the case, teachers might employ different types of teaching methods such as thinking, discussion, and searching for more information. It helps the students work through the facts and analyze the problem and then consider possible solutions and consequences of the actions that they might take.

In cell biology, a good example it can be structure of DNA. The case study could be presented as follows:

As an illustration of the failure to understand life, take the human genome project. I like to say that when they map the human genome they're going to know as much about a human body as you would know about New York City looking at its telephone directory; or as much you would know about a beautiful Peruvian hand-knit sweater if you unravelled it and measured the kinks in the yarn. Would you be able to reconstruct it from those kinks? From that string of kinks, from that series? DNA is usually pictured for us in books as this neat, static double helix, along which we can map its chemical components in a linear chain. First of all, consider the sheer amount of it in your own body. If you could take the DNA in each of your cells, and stretch these bits out end to end about six inches per cell guess how long it would take a jet plane flying a thousand kilometres an hour (I'll do it in kilometres because that makes the zeros easy to work with), to get to the end of your own DNA? Anybody want to hazard a guess? Twenty what? Twenty hours? Would you believe several centuries, flying day and night? We are talking about a serious amount of DNA in every one of us. Do it with the zeros, you have 30 to 50 trillion cells in your body.

4.3. Discussions in large classes

Large group discussions can be an excellent learning tool, but how can we use them in a classroom? Most science teachers do not have the experience to run these types of classes. Preparation and control are the key ingredients. Teachers should use appropriate questions, body language, blackboard planning, and summarization to make it all work. This is method to give students a question during his lecture, and allow them to discuss amongst themselves for 10 minutes and then he lets students give their answers whilst he writes those he thinks are correct or relevant on to an overhead. He gives positive feedback and praise to the students and then finally gives a conclusion about the question.

4.4. Poster

Poster work is another useful team activity for students. It is usually an out-of-class activity for a small peer group. Such activities help students to develop a deeper understanding of what they are learning, through cooperation with one another. In addition it helps them develop design skills and presentation skills. There are other forms of teamwork like the peer group activity, e.g. by using interesting games to motivate students and generate active participation in learning and helping them to understand and consolidate what they have learned.

4.5. Use of concept mapping

Concept mapping is a technique for representing knowledge in a graphical way. There are many concepts in the course of cell biology. Students often get confused with the structures and functions of the different organelles

in the cell, especially the relationship between them. Concept mapping is very useful teaching. It helps a teacher to work out what he or she wants the students to learn. Concept mapping can also be used by students to identify their level of understanding and promote deep learning (Novak and Gowin 1984).

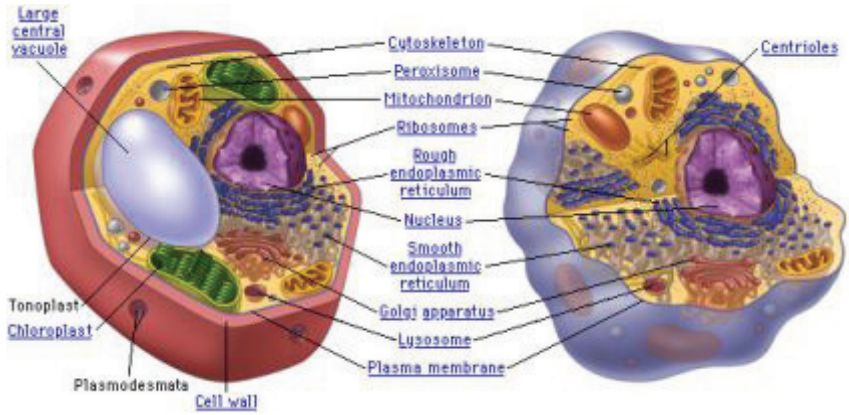

Figure 1. Concept map – Difference between plant and animal cell

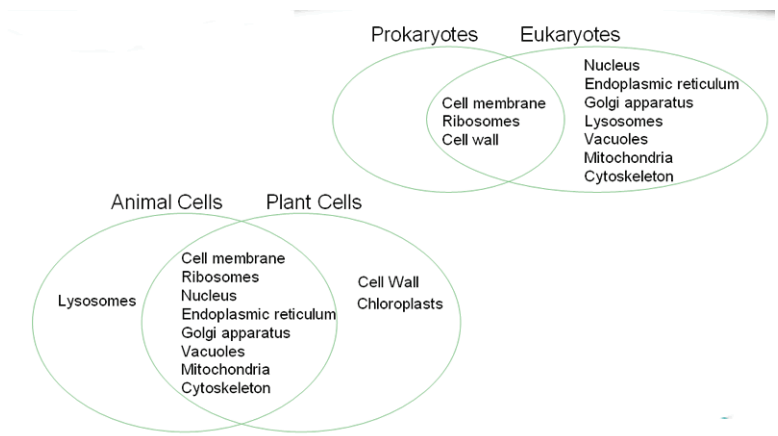

Figure 2. Concept map – Similarities and differences between plant and animal cell

Concept mapping is a technique for representing knowledge in a graphical way. There are many concepts in the course of cell biology. Students often get confused with the structures and functions of the different organelles in the cell, especially the relationship between them. Concept mapping is very useful teaching. It helps a teacher to work out what he or she wants the students to learn. Concept mapping can also be used by students to identify their level of understanding and promote deep learning.

Figure 1 is an example of concept mapping in cell biology: structure and function of animal cell. The map can be used by the teacher to indicate the various linkages between the content and concepts. Alternatively the teacher could ask the students to draw a concept map of the structure and function of an animal cell before the course and then again at the end of the course. This way the teacher can see how much the student has understood.

5. Problems, challenges and possible solutions

To introduce changes into the teaching of cell biology may be difficult at first as there may be opposition to change. The challenge is:

- To get the staff to accept the new teaching direction;
- To introduce curriculum reform, especially methods of assessment; and
- To gain support and encouragement from senior management.

Firstly I will need to gain my colleagues' interest by giving seminars, talking and introducing what I have learned and seen in the University of Stip so that together we can collaborate to new teaching methods. In addition we will need to review the curriculum and introduce changes that will enhance student-centred learning. Changes will need to be monitored by surveys, so that the feedback can be incorporated into the next changes. Most importantly, we need to get strong support and encouragement from senior management.

6. Conclusion

Preparing students for their future requires active classrooms and labs and successful learning, shaping of their personalities that are difficult to change later. Their integration into society later greatly depends on their personal qualities and skills that are largely the product of well-organized and well-completed education, including a warm atmosphere of mutual understanding and experience during their studies.

Trying to implement this idea we have been faced with several problems: How should the world educational process be organized in this rapid development so that students can learn successfully throughout their lives? What are the psychological, pedagogical and social factors that influence successful learning? How successful learning should be assessed? These questions build the foundation of a successful society of tomorrow. These challenges have motivated us to try and find some solutions that further stimulate other research.

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