

USE OF MODERN INFORMATION TECHNOLOGY IN MICROBIOLOGICAL LABORATORY

Dominika Olszewska

Institute of Chemistry, Environmental Protection and Biotechnology
Jan Dlugosz University in Czestochowa (Poland)

Tomasz Prauzner

Institute of Technology and Safety Systems,
Jan Dlugosz University in Czestochowa (Poland)

Piotr Krupa

Institute of Chemistry, Environmental Protection and Biotechnology
Jan Dlugosz University in Czestochowa (Poland)

Pawel Ptak

Institute of Optoelectronics and Measurement Systems Faculty of Electrical
Engineering Czestochowa University of Technology (Poland)

Abstract. *In today's world, the utilisation of modern information technology is becoming increasingly common in educational process – not only at primary and secondary school level, but most of all, at university level. The present article is a proposition of the implementation of information technology as a complement of microbiological laboratories. These classes are, most of all, practical, so a tweak of programs and simulations forms a prominent challenge for an academic. A student, who participates in laboratories, achieves specified abilities, however, he or she does not always have an opportunity to preserve them. In the thesis, there is presented a proposition of innovations, implemented into the educational process, which are a result of a long-time educational practice in terms of educating on the university level. Inasmuch as a complex process of teaching and learning (complete with concurrent components, which qualify its didactic effectiveness) is a subject matter of general didactics, the utilisation of information technology may form an excellent complement of laboratories. The utilisation of such solutions helps students to preserve the practical skills, which they acquire in laboratories. The emphasis is on simulation programs, and the open-source learning management system Moodle, which are considered as educational tools which have a relevant impact on the tenor of learner's cognitive processing. Taking into consideration the advantages of these tools, and the commonness of modern information technology, the authors indicated a large universality of this medium, and its usefulness in the problem and empirical teaching. The presented group of software may bring a significant contribution to the development, the desirability, and the increase of absorption in vocational training. The ponderations are based on the basis of the cognitive theory and the idea of constructive education.*

Keywords: *modern information technology, microbiological laboratory, complex process of teaching.*

Introduction

The article is a proposition of the way of the implementation of computer technology as a complement of microbiological laboratories. These classes are, most of all, practical, so a tweak of programs, simulations, simulation programs and the environment of virtual didactic work forms a prominent challenge for an academic. The article is based on the grounds of the research which shows that the work of students, who participate in the Internet course, is more effective and their knowledge is wider. It is very substantial that the article presents solutions which were employed during laboratories – purely practical classes.

Theoretical substantiation of the problem

In today's world, the utilisation of modern methods and teaching aids is becoming increasingly common in the educational process – not only at primary and secondary school level, but most of all, at university level. The didactic process is formed not only by students, learning program and lecturers but also by omnifarious modern technologies and ITC Technologies. More and more students use only online sources, which started to eliminate textbooks and academic books. Thereupon there have been created more and more extensive and developed databases. Due to that, the option for an impact on the didactic process expands (if we use multimedia and Internet tools properly) (Mehrabi & Masoumeh, 2012). The utilisation of platforms, such as Moodle, and simulation programs (which are used as tools which substitute or complete courses at universities), is getting more and more common. This method holds good in case of humanistic programs and language acquisition. Unfortunately, there is a problem, which is caused by the implementation of these techniques to the teaching process of general science, especially from the area of life science. Until now IT tools were used in branches of knowledge only during lectures and conservatories but it is increasingly necessary to fortify practical classes, such as laboratories, with them (Brooks, 2010). Some of the subjects can be easily adapted to the utilisation of modern computer techniques, the other ones present a fair challenge for an academic.

A student, who participates in laboratories, achieves specified abilities (such as knowledge of: techniques of culturing microorganisms, the making of microscopic slides, etc.), however, he or she does not always have an opportunity to preserve them. During work with young people, we can notice that they have difficulty with memorisation, for instance, they cannot make a note of the order of relevant operations or they do not know how to use a given technique properly. There is no doubt that there may be a few reasons why it happens: too large number of participants in groups, insufficient amount of

didactic hours and laboratories which are not available all the time – it all makes that students’ skills are not satisfactory. More and more young people have trouble with finding a job in their fields, or just after graduation they have to complete post-graduate studies or extra training courses.

To respond to this issue, the utilisation of modern IT tools was offered as help to enrich General microbiology and Food microbiology laboratories in the fields of study: Biotechnology and Dietetics.

On Moodle platform, there has been compiled an online course, which is ment to help to perpetuate practical skills, and also to benefit from a simulation program and to compare the results of this simulation program to the real experiments, which students can do on their own or in groups. (Noga et al., 2017). The utilisation of the latest information and communication technology in the process of education has a profitable impact on the quality of this process, provided that methods based on this technology are prepared properly, premeditated, and corresponding to the current working conditions and a class profile (Prazuner, 2012).

Discussion

The supplementary General microbiology course (on Moodle platform) has been devided into steps and it consists of, most of all, instructional films, which show in details the techniques of microbiological laboratory work. The next step is made up of quizzes, which enable to examine acquired information. An instructional film, which explains how to do streaking, sets a great example.



Fig. 1. Microbiology course on Jan Długosz University in Czestochowa Moodle platform (own data source)

During laboratories, the majority of students forget to anneal and to cool an inoculation loop between the particular phases of culture. The quality of culturing (done by students) streamlined due to multiple video replay and taking the quizzes on the platform. Students do exercises much more efficiently and precisely, so a lecturer can do a talk seamlessly, and there is no need to repeat some of the subject matters and to explain them once again.

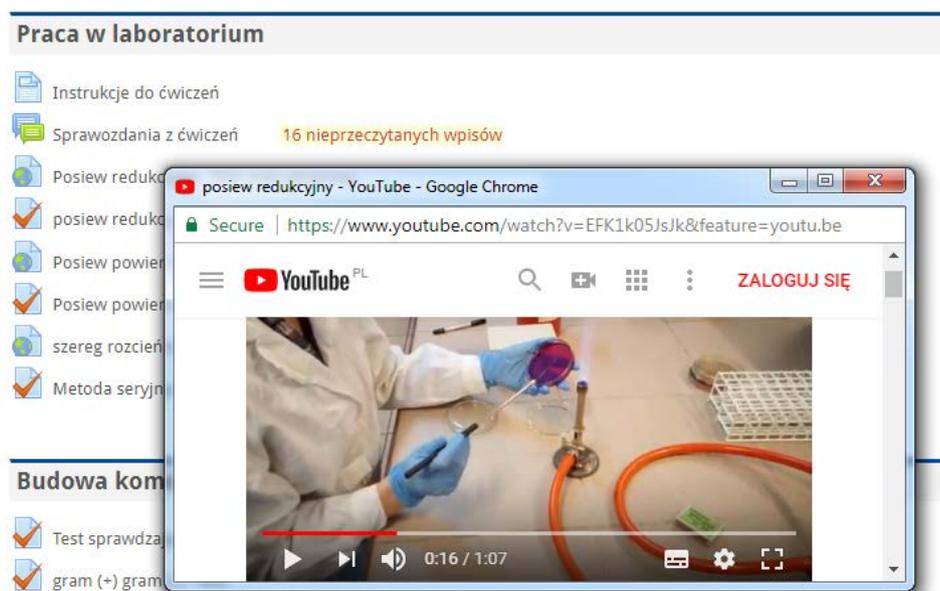


Fig. 2. An exemplary instructional film on Moodle platform (own data source)

The same situation relate to the skillfulness at confecting of serial dilutions of the sample. Students have a huge problem with making mental notes of the order of relevant operations. As in the case of culture, a student can watch a film and take a checking quiz.

The putting of exemplary photographs of bacteria under a microscope holds good, moreover, it uprated students' skill of making distinctions of Gram-positive and Gram-negative bacteria.

There also have been implemented online discussion groups and chats, which simplify to share results, which they drew during laboratories. They discuss conclusions and analyse mistakes. It has an enormous impact on the quality of reports, and it decrease the number of mistakes, which students make during classes. Especially, awareness of sterile working conditions and preservation of sterile conditions during culture have increased prominently.

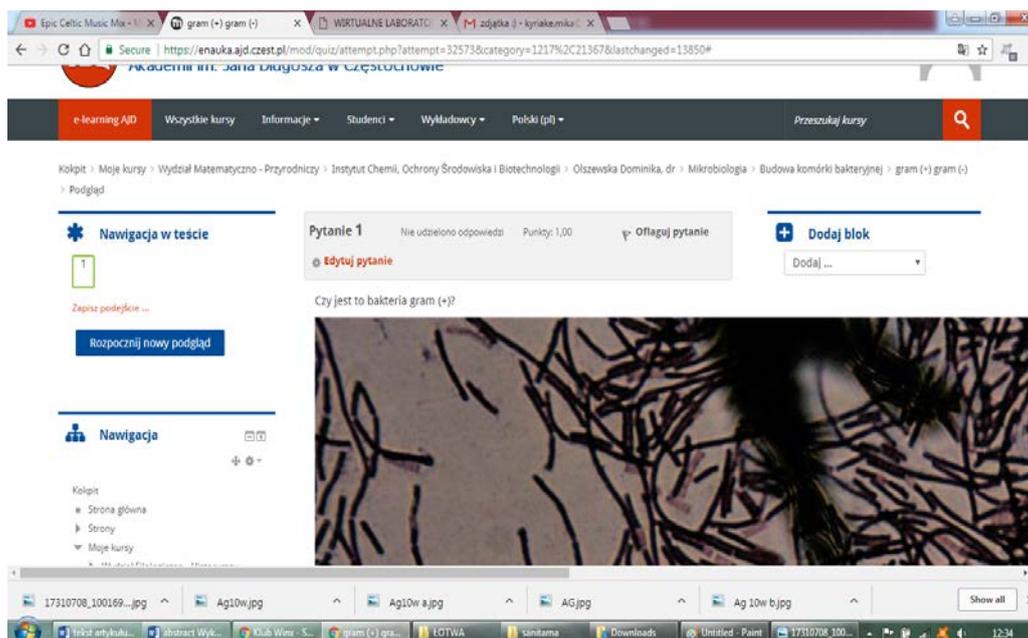


Fig. 3. An exemplary question from a checking test which examines the knowledge of morphological bacteria forms (own data source)

A lot of experiments which use germs, and that young people need at professional work, are very expensive and require specific equipment as well as plenty of time. Not every university or academic institution can purchase costly equipment nor can extend Microbiology classes. Therefore, a various kind of simulation programs, that is predictive microbiology, is used to make such microbiological analysis. They make it possible to determine how microorganisms will grow, and predict, for example, the inactivation and the activation level of microorganisms. Based on mathematical dependents, predictive microbiology determines behaviour of microorganisms in specified environmental conditions, such as temperature, the pH, availability of acid and organic salts, and oxygen (Tarczyńska et al., 2012).

In the process of creating the classes, we can use the following forecasting models:

- the primary models, which are utilised to determine the elementary parameters of the growth of germs, the length of lag phase λ , and the factor of growth rate μ in specified environmental conditions;
- the secondary models present the changes of parameters, which are defined by the primary models depending on the environment;
- the tertiary models are a combination of the primary models and the secondary models; they were created as computer programs and were used to make simulations of the development of germs in various environmental conditions (Kowalik et al., 2011).

The most famous and didactically valuable forecasting models are: the ComBase Predictor (the model of Barnyi and Roberts), Pathogen Modeling Program (the Gompertz model), and the Pathogen Modeling Program (PMP70). The ComBase Predictor model was created with the aid of a database of the development of many microorganisms, which live in food products and culture medium for microorganisms, and also including developing environmental factors. The database proceeded from experimental data (Kowalik et al., 2012).

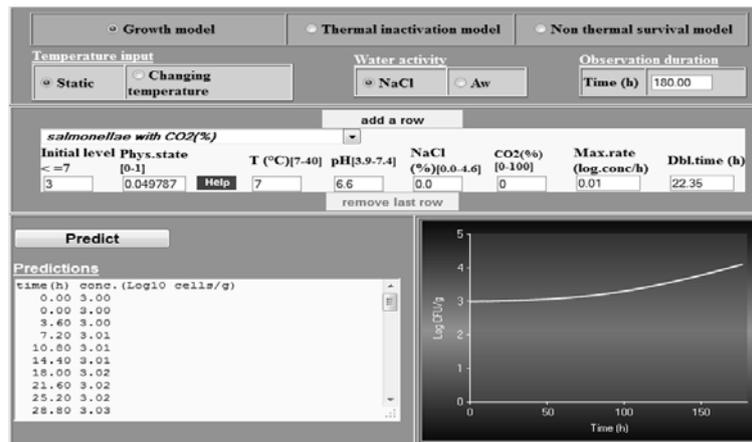


Fig. 4. An exemplary screen of ComBase Predictor which charts the growth forecast of *Salmonella* cells (source: www.combase.cc)

The implementation of such an innovative type of complement to laboratories improved effectiveness of the teaching process significantly. Students absorb practical skills better and faster due to the virtual repetition. Modern computer techniques and simulation programs have a meaningful impact on the educational process because they accommodate to the modern world, and breed students who will know how to use modern technology at their works, and who learnt to think critically and out of the box (Woźniak et al., 2006).

By virtue of cognitive science, the implementation of these tools was preceded by the analysis of the didactic process during acquiring practical skills in laboratories. Cognitivism is a neurobiological concept, which was grounded on the understanding of the functioning of the brain, and its abilities to gaining and memorising knowledge, so the use of modern technologies is immediately obvious (Prazner, 2016). The present generation of young people lives mainly in a virtual world and sources information from the Internet. To achieve a didactic success, lecturers should accommodate to interests and capability of learners, and they have to adjust curriculum and the way of teaching to students' needs. Lecturers drop serving of ready-made solutions and, somewhat, they force pupils to independent thinking, group working, making inferences, and analysing information. Such an approach is compatible with the idea of

constructivism, which is founded on recognition of student's individual and cognitive abilities. The employing of modern technology is very important because it features unassisted resolving an issue by a student – not only by experiments and experiences in laboratory but also by perpetuation and repetition of brand new information (Prazzner, 2017).

Due to such types of solutions the time of doing particular exercises in laboratories has reduced to the minimum. Students are getting more and more meticulous and they plan on experiments way better. The understanding of vocabulary and microbiological issues refind in comparison to classes which did not exploit Moodle platform and simulation programmes. The process of enhancement of didactic effectiveness continues and it is founded on observations and comments of students themselves.

Methodology

Our students, who study Biotechnology and Dietetics, took part in the research. On the basis of data, Internet tools were modified and improved. Students answered the question by gauging the rightness (in the scale of 1-5) of the given statements. I created a survey, and I asked my students to respond to it. The questions, which were used in the research:

1. Do you think that the utilisation of didactic materials published on Moodle could appeal to the execution time of an exercise?
2. Did the proposed simulation programs let you understand relevant microbiological vocabulary better?
3. Did your command of the laboratory working techniques increase due to the films and the other material published on Moodle platform?
4. Is your awareness of sterile working conditions better due to the utilisation of modern IT techniques?
5. Does the utilisation of a chat and a forum on Moodle platform improve analytical skills and effectiveness of inference?

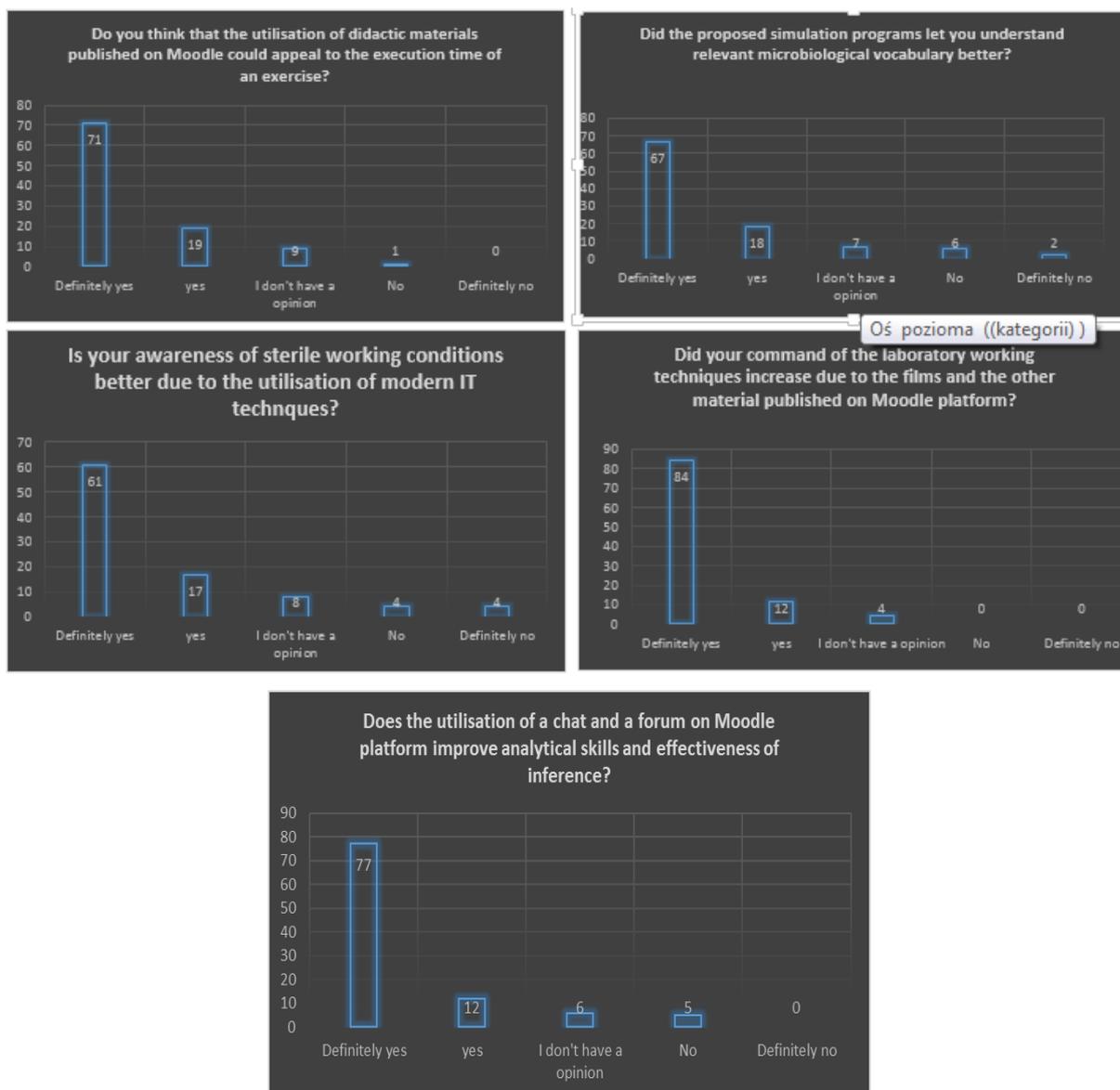


Fig. 5. The results of the survey

Concluding remarks

Concerning the question if the utilisation of didactic materials published on Moodle could appeal to the execution time of an exercise, a considerable amount of students (71 %) responded “definitely yes”, 19 % said “yes”. A slightly less than the first group (67 %) claim that simulation programs let them understand relevant microbiological phenomena. And now, we are going to analyse the answer “definitely no” – 2 %. It may be caused by the fact that some students do not want to or cannot use simulation programs because it is much more time-consuming than taking part in an Internet course.

The most of interviewees – 96 % in total – responded “definitely yes” and “yes” to answer the question if students improved the knowledge of working techniques and microbiological vocabulary. There was no negative reply. It proclaims that the opportunity of multiple exploit of materials, which are available on an e-learning platform, helps to perpetuate abilities acquired during laboratories in a much better way.

Concerning the question about the utilisation of chats and an interned forum, 77 % of students gave a positive reply. In the beginning of the course, the utilisation of these tools was small. In the end, it became very popular as a tool of a communication between students. The answer “no” was picked by only 5 % of respondents. It can be caused by student’s individual approach of public expression.

On the other hand, 8 % of respondents said “no” and “definitely no” to answer the question about the improvement of awareness of sterile working conditions. It may be a result of the fact that the practical experience is very needed to preserve the sterile conditions during microbiological culturing.

In all, the substantial majority of interviewees comment on proposed solutions in a very positive way. It suggests that such types of tools simplify the achievement of practical skills, and the preservation of new information acquired during laboratories.

In the opinion of an lecturer, there can be noticed the development of work efficiency, not so significant, if we would like to take into consideration the results of the examination, but it is big enough to continue such a complement of microbiology course.

Summary

The implementation of modern computer techniques, as a complement of microbiological laboratories, has improved the didactic process significantly. The use of Internet tools, ITC Techniques and simulation programs relevantly raise the productivity of education and let students improve their skills. Their command of the laboratory working techniques and awareness of sterile working conditions has increased. On the grounds of the survey data, we can notice that such a complement of microbiological laboratories improves and makes work more attractive. It also raises didactic productivity and it helps to educate finer specialists. The vast majority of students, who took part in the research, admit that sharing of virtual didactic material, watching instructional films, and having an opportunity to exchange their observations on an Internet forum have improved their practical skills (used during microbiological laboratories) increasingly. The utilisation of simulation programs during microbiological laboratories still causes a problem, but there are implemented procedures relating to the improvement of the educational process to utilise such types of solutions to stimulate students to take up a challenge, and to bring to perfection their practical skills.

References

- Brooks, J. (2010). Academic E-Learning Helps Anatomy & Biology Students Make the Grade. Retrieved from <http://blogs.articulate.com>
- Korczak, J., & Woźniak, D. (2008). *Zastosowanie nowoczesnego e-learningu i multimediów w edukacji*. Zeszyty Naukowe Instytutu Ekonomii i Zarządzania. Koszalin: Wydawnictwo Uczelniane Politechniki Koszalińskiej
- Kowalik, J., Zuzga, E., & Tarczyńska, A. (2012). Zapewnianie bezpieczeństwa zdrowotnego mleka i produktów mleczarskich w łańcuchu chłodniczym, *Journal of Management and Finance, Vol 3, part 2*. Gdańsk: Wydawnictwo Uniwersytetu Gdańskiego
- Kowalik, J. (2011). Prognozowanie na nowo. *Forum Mleczarskie Biznes 1/2011 (10)*.
- Mehrabi, J., & Masoumeh, A. (2012). Teaching with Moodle in higher education. *Procedia-Social and Behavioral Science, 47*.
- Noga, H., Olszewska, D., Ptak, P., Prauzner, T., & Migo, P. (2018). Badanie i symulacja oddziaływania zmiennego pola elektromagnetycznego na rozwój mikroorganizmów. *Przełąd Elektrotechniczny, R 94, Nr 1*.
- Prauzner, T. (2017). The effectiveness of school education - featured implications considerations. *Society. Integration. Education. Proceedings of the International Scientific Conference. Volume III, May 26th-27th 2017*, Rēzekne: Rēzeknes Augstskola, Latvia.
- Prauzner, T. (2016). Interactive computer simulation as a response to contemporary problems of technical education. *Society. Integration. Education. Proceedings of the International Scientific Conference. Volume II, May 27th-28th 2016*, Rēzekne: Rēzeknes Augstskola, Latvia.
- Prauzner, T. (2012). Metodologia nauczania w szkole wyższej. *Kształcenie zawodowe: Pedagogika i Psychologia*. Polsko-Ukraiński Rocznik Ukraińsko-Polski. Częstochowa-Kijów: Wydawnictwo Akademii im. Jana Długosza w Częstochowie.
- Tarczyńska, A., Kowalik, J., & Łobacz, A. (2012). Modelowanie mikrobiologicznego bezpieczeństwa żywności. *Przemysł Spożywczy. Vol 6*
- Woźniak, D., Królikowski, T., & Bałasz, B. (2006). E-learning w nauczaniu jako technologia postępu edukacyjnego. *Nowe technologie w kształceniu na odległość*. Koszalin: Wydawnictwo Uczelniane Politechniki Koszalińskiej.