Linking Assessment to e-Learning in Microbiology and Toxicology for Undergraduate Students

Lorentz JÄNTSCHI, Carmen Elena STOENOIU, Sorana Daniela BOLOBAÇ

lori@academicdirect.org, carmen@academicdirect.ro, sbolboaca@umfcluj.ro

http://vl.academicdirect.ro/general/chemistry/microbiology_toxicology

Development of communication and information technology opens the possibility to create new learning and assessment tools. Beyond the world wide access to education across the country and globe, the opportunity of running virtual experiments and assisting processes modelling, the communication and information technology facilitate implementing of collaborative learning, promoting active implication of students in the process of acquiring knowledge at the same time being more frequently used in the process of education. Therefore the concept of computer-assisted assessment, that was first introduced and used for the analysis of knowledge assessment is necessary to be as objective as possible. Starting with experiences obtained by creation of online assessment systems for general chemistry, and from the necessity of a valid and reliable assessment, an auto-graded system has been developed. The aim of present research was to assess the methodology of microorganisms knowledge of fourth year students at the Faculty of Materials Science and Engineering from the Technical University of Cluj-Napoca, Romania by using the developed knowledge evaluation system. The system is based on the binomial distribution hypothesis, and the created knowledge is the randomization of the statements and the options’ order. The students had the possibility to familiarize with the testing system before the examination as many time as they wanted. The testing system comprises two main components: (1) an assessment engine (the hardware and software required to create, store and deliver a test, and to create and to store students information and to manage with testing results, and (2) a multipurpose question bank. A detailed presentation of the assessment engine will be described in [25]. The system has been used in order to (1) the creation of MCQs bank (creation and storing of new questions, and changing of previously created questions), and (2) students’ knowledge assessment. The system compute the final mark by auto-graded, based on all parameters stored in the question bank, being able to display the interest parameters, and to plot the mark distribution. The results were analyzed and interpreted using classic statistical methods and/or computer aided learning activities. At the beginning of the course, the aim of the research was presented and the students had the possibility to enrol voluntarily into the team responsible with the creation of the Microbiology and Toxicology course. According with course description and with the subject matter, the Microbiology and Toxicology course contains tutorials and laboratory sessions, and at the end of the course the students will be able to: (1) give an overview of the field of Microbiology and Toxicology and (2) get familiar with the most important technical and theoretical aspects of the field. The students will be also able to: (3) identify the interactions of different biological and chemical processes and (4) learn about the interactions between different microorganisms and toxins. The students will be able to: (5) identify the interactions of different biological and chemical processes and (6) learn about the interactions between different microorganisms and toxins. The students will be also able to: (7) explain the significance of microorganisms and toxins in the environment and (8) understand the role of microorganisms and toxins in the environment. The students will be able to: (9) explain the significance of microorganisms and toxins in the environment and (10) understand the role of microorganisms and toxins in the environment. The students will be also able to: (11) explain the significance of microorganisms and toxins in the environment and (12) understand the role of microorganisms and toxins in the environment. The students will be able to: (13) explain the significance of microorganisms and toxins in the environment and (14) understand the role of microorganisms and toxins in the environment. The students will be also able to: (15) explain the significance of microorganisms and toxins in the environment and (16) understand the role of microorganisms and toxins in the environment. The students will be able to: (17) explain the significance of microorganisms and toxins in the environment and (18) understand the role of microorganisms and toxins in the environment. 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The Number of Tests Distribution

<table>
<thead>
<tr>
<th>Year</th>
<th>Number of tests</th>
<th>Mean</th>
<th>StDev</th>
<th>Median</th>
</tr>
</thead>
<tbody>
<tr>
<td>2005-2006</td>
<td>59</td>
<td>1.04</td>
<td>0.59</td>
<td>0.9</td>
</tr>
<tr>
<td>2006-2007</td>
<td>50</td>
<td>1.06</td>
<td>0.58</td>
<td>0.9</td>
</tr>
</tbody>
</table>

For absolute frequency; f = absolute frequency; 95% CI = 95% confidence intervals

Correct Answer score vs average time per correct answer

Correct Answers Scores and Average Time Per Correct Answers: Single or Twice vs Evaluation more than twice

<table>
<thead>
<tr>
<th>Year</th>
<th>Mean Time</th>
<th>Correct Answers Score</th>
<th>StDev</th>
<th>Median</th>
</tr>
</thead>
<tbody>
<tr>
<td>2005-2006</td>
<td>2.06</td>
<td>7.84</td>
<td>5.63</td>
<td>5.6</td>
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Discussion

The evaluation of the students’ knowledge is an obligatory task at the end of a course of undergraduate studies. As an element of the education process, the knowledge gained and the testing process, methods and fairness testing with multiple-choice questions are frequently used. The presented study reveals that the students’ knowledge in Microbiology and Toxicology is effective, and the ability to analyze the results is being matched. The majority of the students performed the test once or twice (see second Table). A simple observation shown that the students that performed the tests in 2005-2006 academic year had a large range between first and last evaluations comparing with the ones from 2006-2007 academic year. This could be explained by the fact that students are in correspondence with their study topic and/or the students’ abilities to work with the e-assessment environment. Generally, the average time per correct answers were used for the analysis of the scores. As observed in the presented study, the test on 2005-2006 academic year was greater comparing with the average obtained by students that performed the test on 2006-2007 academic year. These differences vary from 0.4 (for students that performed three tests) to 0.25 (for students that performed one test) (see Table). The same observation can be made when comparing the questions with one, two, three, and four correct answers from the questions bank (see Table). The distributions of the number of evaluations expressed as relative and absolute frequencies and associated 95% confidence intervals are presented in second Table.

Concluding remarks

The proposed e-assessment system proved to offer a more flexible learning and teaching environment when compared with first evaluation when was applicable, showing an improvement in acquired knowledge and Microbiology and Toxicology knowledge. According to the test difficulty, a high number of students presented to the test the first time when they begin the test and end (y/n mm dd hh:mm:ss format, where y = year (e.g. 06 for 2006), mm = month (e.g. 02 for February), dd = day (e.g. 18 for eighteen), hh = hour (e.g. 09 for 9 am), mm = minute (e.g. 12), ss = seconds (e.g. 41)), the number of correct answers, the average time per correct answer, the points of evaluation. Data were collected into a database and summarized and analyzed with Statistica software at a significance level of 5%. The 95% confidence intervals for proportions were calculated by using of an original method, based on the binomial distribution hypothesis.

Selected references

- Nauck N, Gaianchi C, Multiple choice examination system 1. Database Design and Implementation for General Chemistry, LSJ, 5, p. 18–33, 2004
- H. Balsam, L. Jäntschi, Multiple choice examination system 2. Online Quizzes for General Chemistry, LEPT, 5, p. 26–36, 2004

For absolute frequency; f = absolute frequency; 95% CI = 95% confidence intervals