IMPACT OF MODERN EDUCATIONAL TECHNOLOGIES ON LEARNING OUTCOMES

Application for e-Learning in Biomedical Engineering

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KEY TERMS

Biomedical engineering

- Multidisciplinary field of science:
  - Significant impact on human health and well-being,
  - Advanced knowledge in engineering, biology and medicine.

Educational technology

- Goal oriented problem-solving approach utilizing tools, techniques, theories and methods from mutiple knowledge domain.

E-Learning

- The use of various technological tools that are either Web-based, Web-distributed or Web-capable for the purpose of education.

Virtual campus

- Open system for for the desing, deployment and evaluation of reusable learning materials.

Learning outcomes

- Statements what students are expected to achieve.

BIOMEDICAL ENGINEERING

- Bioelectromagnetism
- Biomechanics
- Prosthetic devices and artificial organs
- Medical imaging
- Biomaterials
- Biotechnology
- Tissue engineering
- Neural engineering
- Biomedical instrumentation
- Bionanotechnology
- Physiological modeling
- Rehabilitation engineering
- Medical and bioinformatics
- Clinical engineering
- Biosensors
- Medical and biological analysis
- …

EDUCATIONAL TECHNOLOGY

- Internet and World Wide Web
  - Web-based applications
  - E-mail, chat, and instant messaging replacing traditional forms of communication
- Mobile Technologies
  - Personal handheld computers
  - Cell phones
  - Laptops
  - Wireless devices
- Video Transmission
  - Conferencing
  - Internet-based
  - Cell-phone based
- Internet2
  - Video streaming of multimedia content
  - Use of remote instruments such as microscopes

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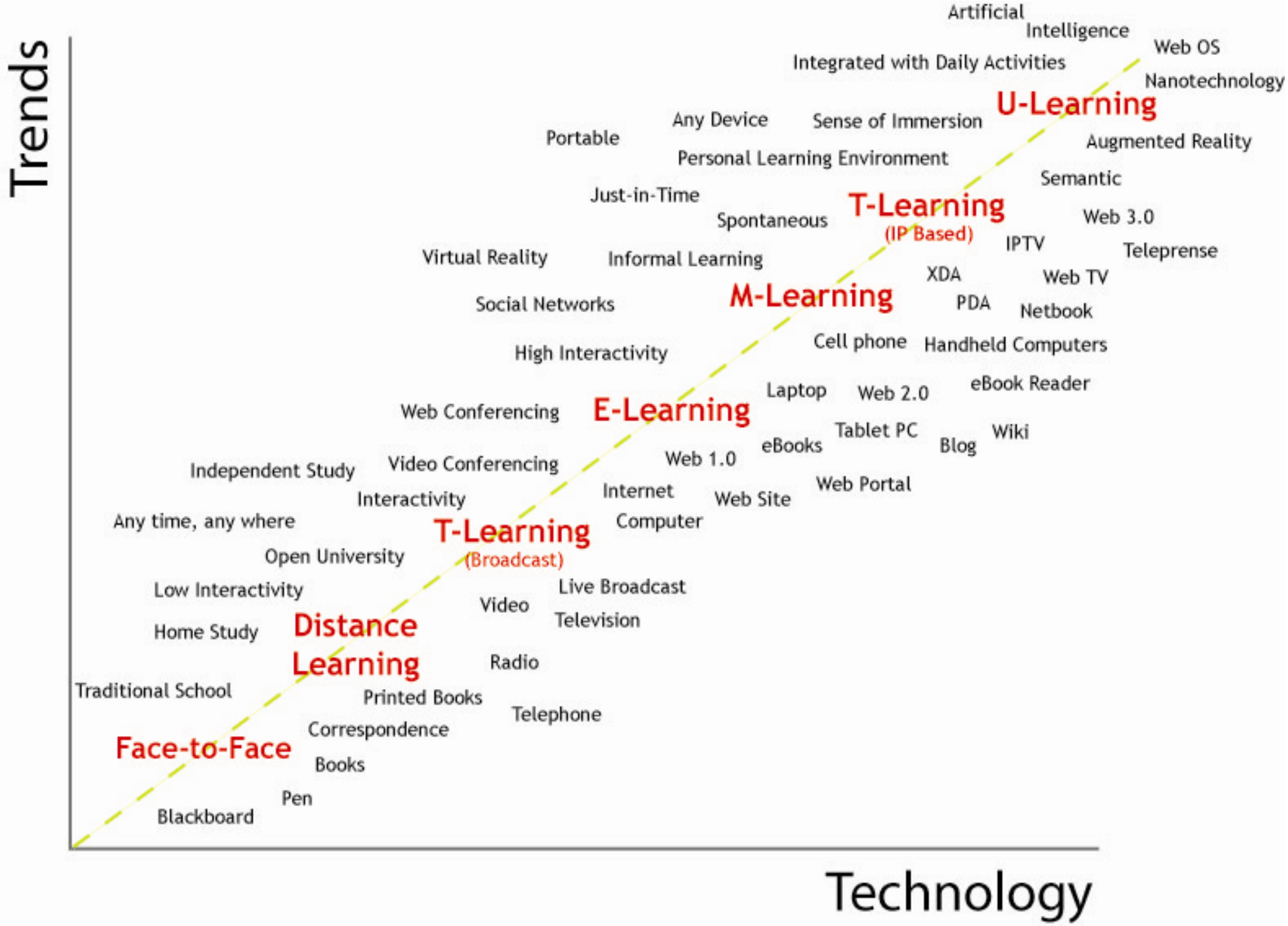
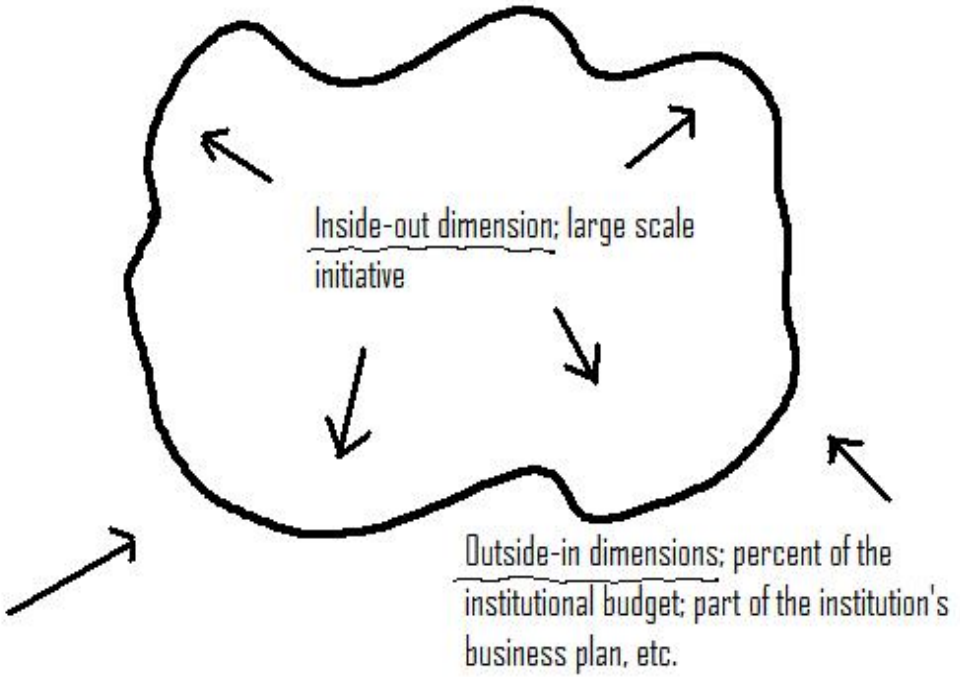


Learning Trends vs Technology © Özlem Ozan & Yasin Özarslan, 2009

VIRTUAL CAMPUS

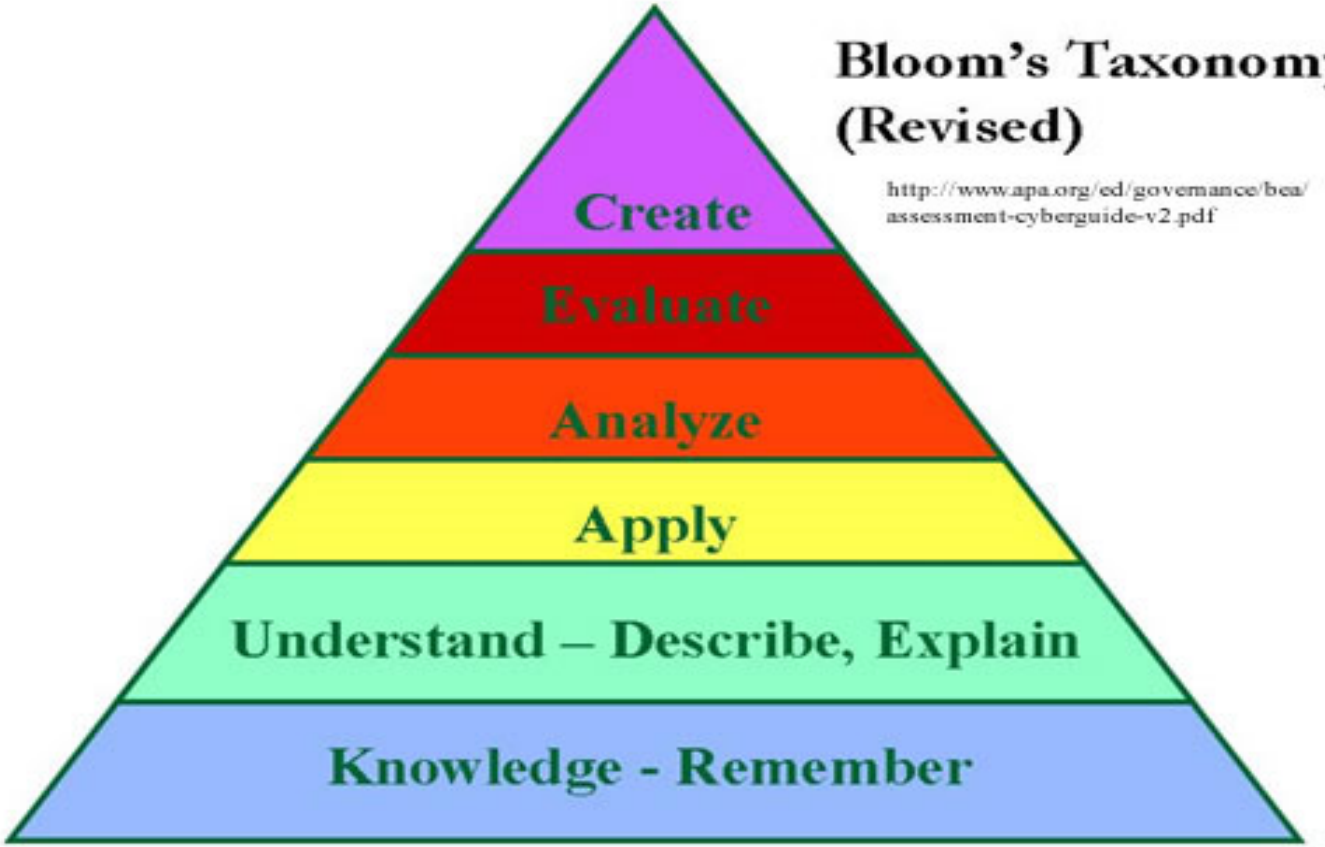
Actors:

- Learner
- Teacher
- Content-expert
- Manager
- Designer



ReViCa Project

LEARNING OUTCOMES



Based on an APA adaptation of Anderson, L.W. & Krathwohl, D.R. (Eds.) (2001)

BACKGROUND

EUROPEAN VIRTUAL CAMPUS FOR BIOMEDICAL ENGINEERING, EVICAB:

- The aim to develop, build up and evaluate sustainable, dynamic solution for virtual mobility and e-learning:
  - Mutually support the harmonization of the European higher education programs.
  - Improve the quality of and comparability between the programs.
  - Advance the post-graduate studies, qualification and certification.

EVICAB
(January, 2006 - December, 2007)

Activities:

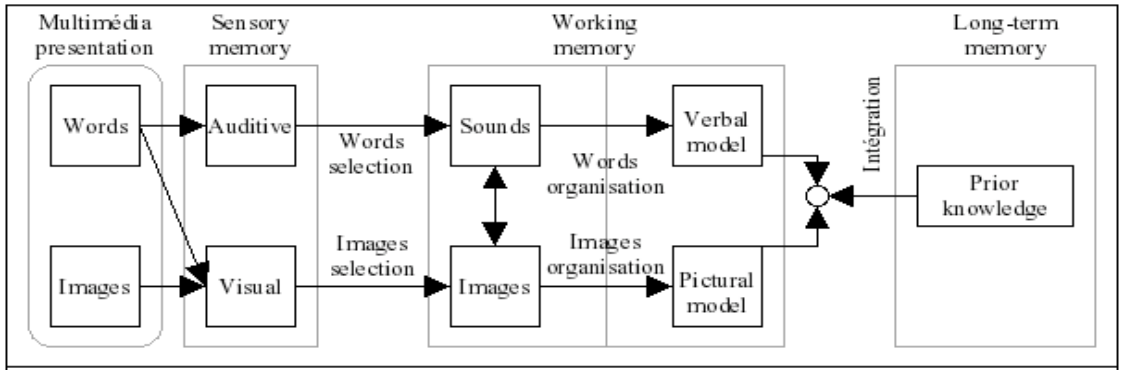
- Evaluating existing Biomedical Engineering e-curricula and strengthening the harmonization process.
- Building up a common virtual pilot Biomedical Engineering curriculum among the partners.
- Developing a model to dynamically elaborate and innovate sustainable e-courses.
- Developing new practices for e-teaching and e-learning.
- Developing new administrative practices.
- Evaluating and disseminating results.
- Managing project.

OBJECTIVES OF THE STUDY

1. Review learning theories and technologies.
2. Develop the virtual campus.
3. Evaluate how students accept e-learning.
4. Analyze the development process of e-learning.

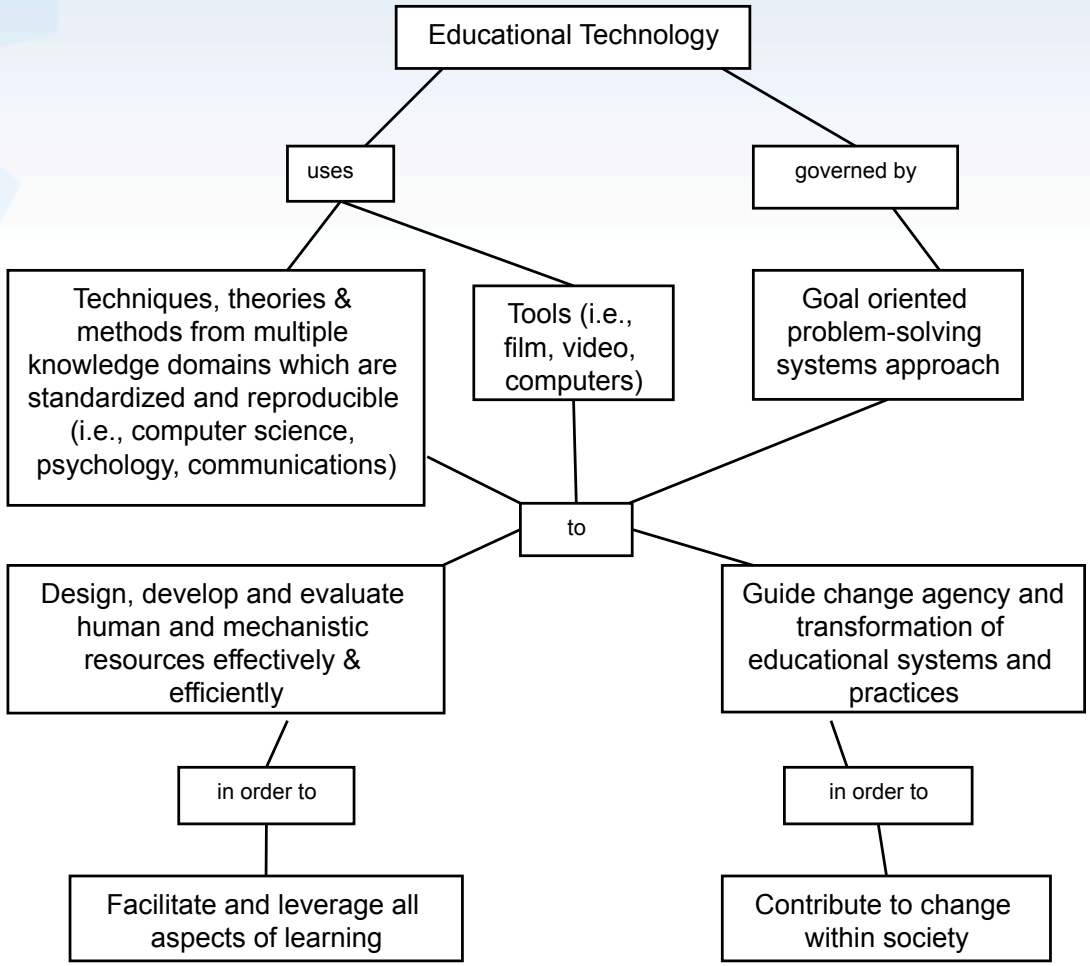
LITERATURE REVIEW
Learning theories

- Dual coding theory: visual and verbal codes.
- Cue summation theory: stimuli in multimedia environment.
- Atkinson-Shiffrin model: multi-memory model.
- Cognitive load theory: working memory.
- Generative learning theory: self-reliance among students.
- Mayer's theory of learning: multimedia learning.
- Gagner's Information processing theory: different types of learning.
- …



Model of multimedia learning (Mayer, 2001)

LITERATURE REVIEW
Educational technology

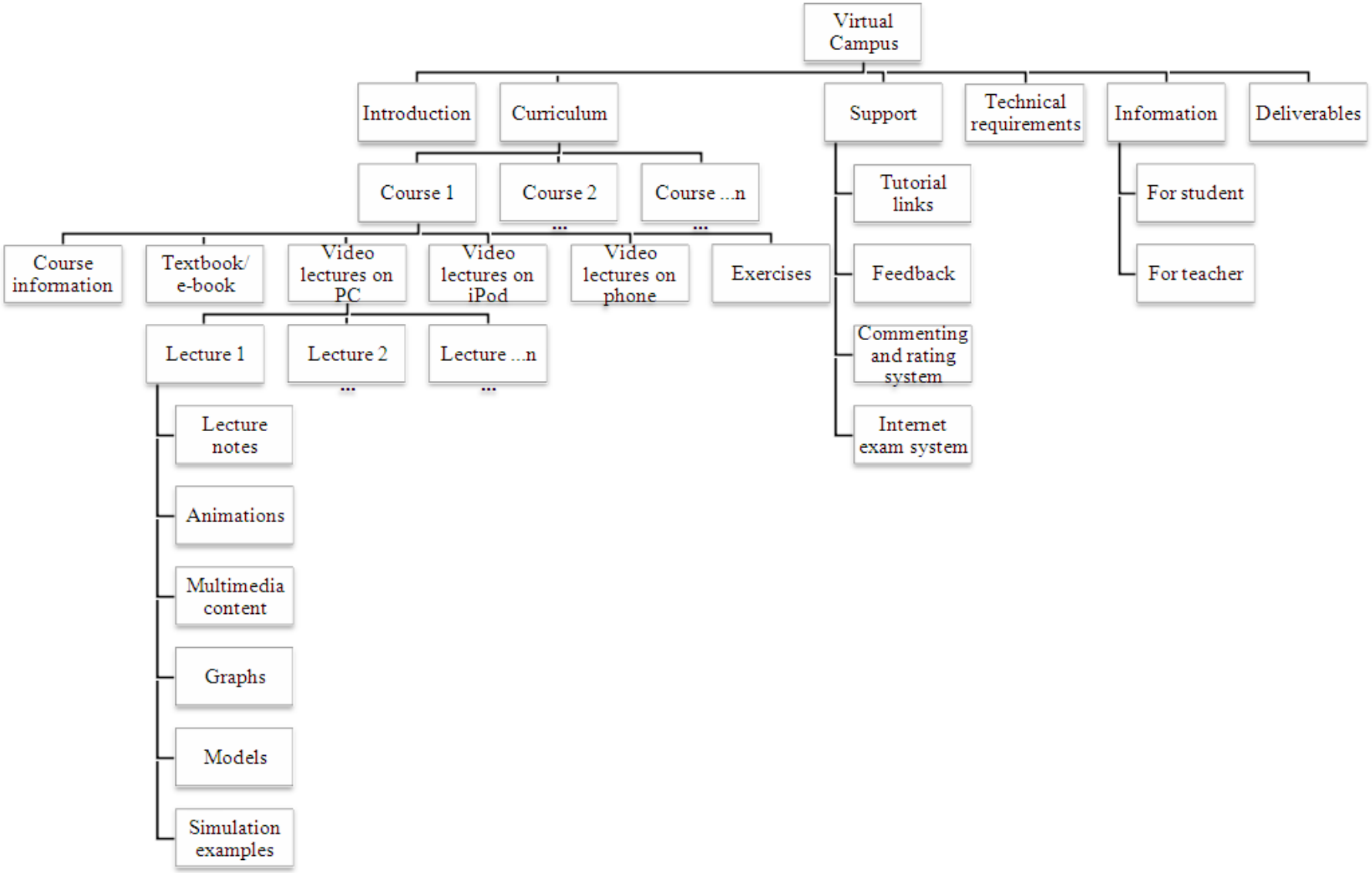


A systems definition of educational technology in society. Adapted from Luppicini 2005.

MATERIALS AND METHODS

1. Theoretical approach
   - Literature review
3. Practical approach
   - Software tools
   - Harware tools
4. Evaluative approach
   - Questionnaires
   - Web statistics
5. Developmental approach
   - International survey

RESULTS
Theoretical approach



RESULTS Metadata

Biomedical Engineering Curriculum

BIOELECTROMAGNETISM							
Teacher	Course	Book	Video	iPod	Phone	Slide	Exercise
Jaakko Malmivuo: Bioelectromagnetism							
Frank Sachse: Computational Modelling of Cardiovascular System							
Risto Ilmoniemi: Transcranial Magnetic Stimulation							

BIOMECHANICS							
Teacher	Course	Book	Video	iPod	Phone	Slide	Exercise
Rami Korhonen: Biomechanical Modelling of Bone and Cartilage							

OPTICS							
Teacher	Course	Book	Video	iPod	Phone	Slide	Exercise
Goran Salerud: Biomedical Optics							

SIGNAL AND IMAGE ANALYSIS							
Teacher	Course	Book	Video	iPod	Phone	Slide	Exercise
Jiri Jan: Introduction to Biomedical Signal Analysis							
Rangaraj M. Rangayyan: Biomedical Signal Analysis							
Rangaraj M. Rangayyan: Biomedical Image Analysis							

Internet Education Tool in Evicab Moodle

For suggestions and inquiries and for reporting on problems, please use the Feedback Page

TAMPERE UNIVERSITY OF TECHNOLOGY

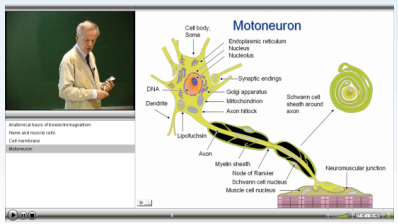
RESULTS
Practical approach

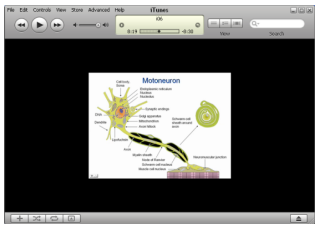
Software tools:

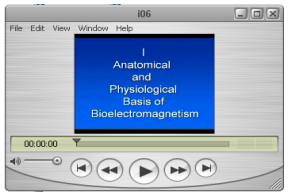
- Internet
- Media players
  - Adobe Flash
  - iTunes, Quick Time
- Video and audio editing software
  - Camtasia Studio
  - Windows Movie Maker

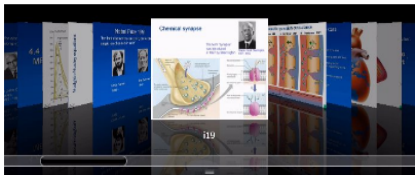
Hardware tools:

- Computers
  - Windows, MacOS
- Portable video and audio players
  - iPods, MP3 players
- Media phones



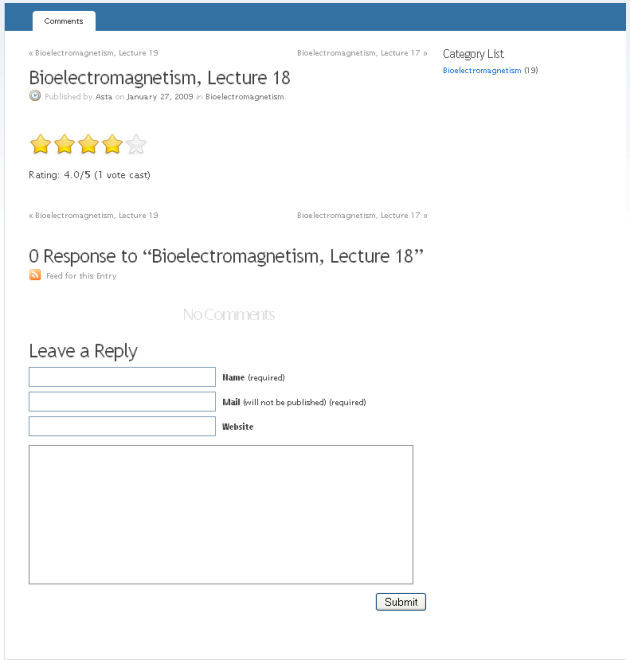






RESULTS
Learning objects

- Video lectures
- e-Book
- Virtual interactivity system
- Quizzes and exercises
- Lecture notes
- Animations
- Virtual models and simulations
- Internet examination
- Laboratory works
- Moodle
- Video conferencing

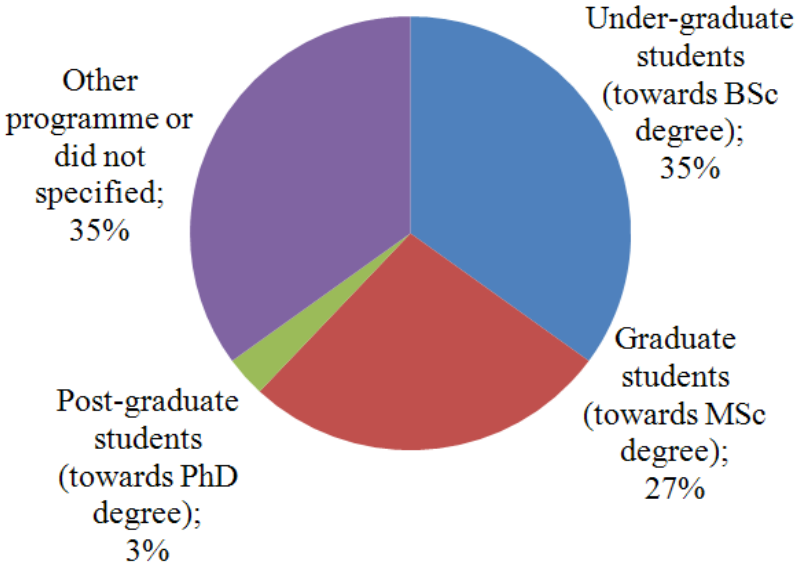


VIDEO LECTURES

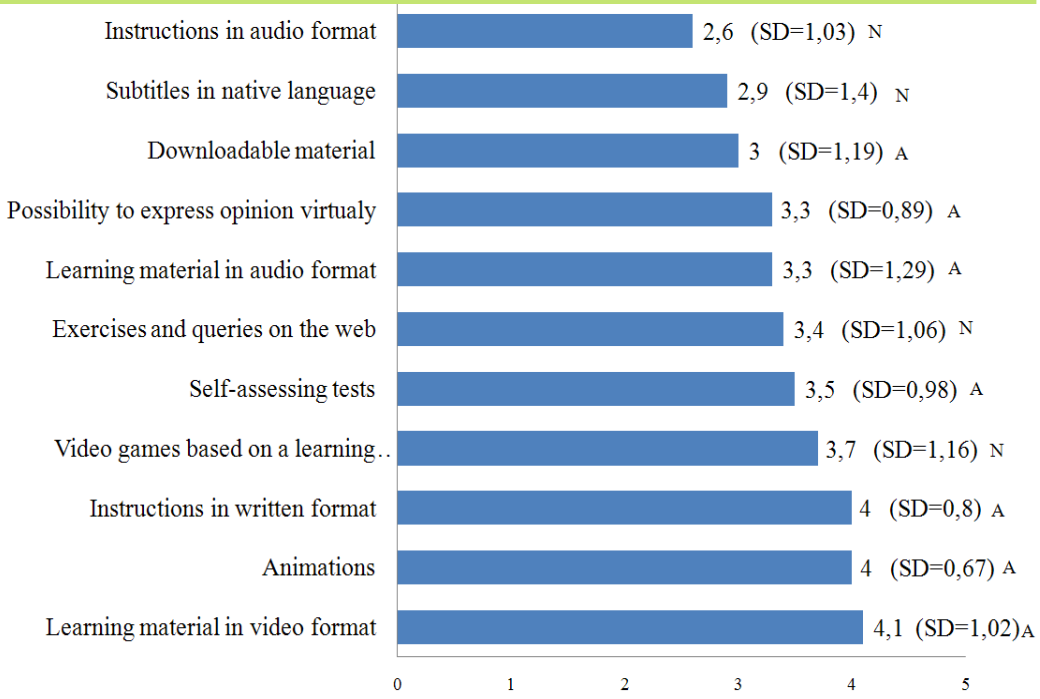
Motivation:

- To grasp students' attention and motivate them to learn.
- To provide highly realistic depiction of situation, which students would not otherwise have the occasion to see:
  - Medical procedure,
  - Lecture in another university.
- To watch again or later recorded live face-to-face lectures.

RESULTS Questionnaire

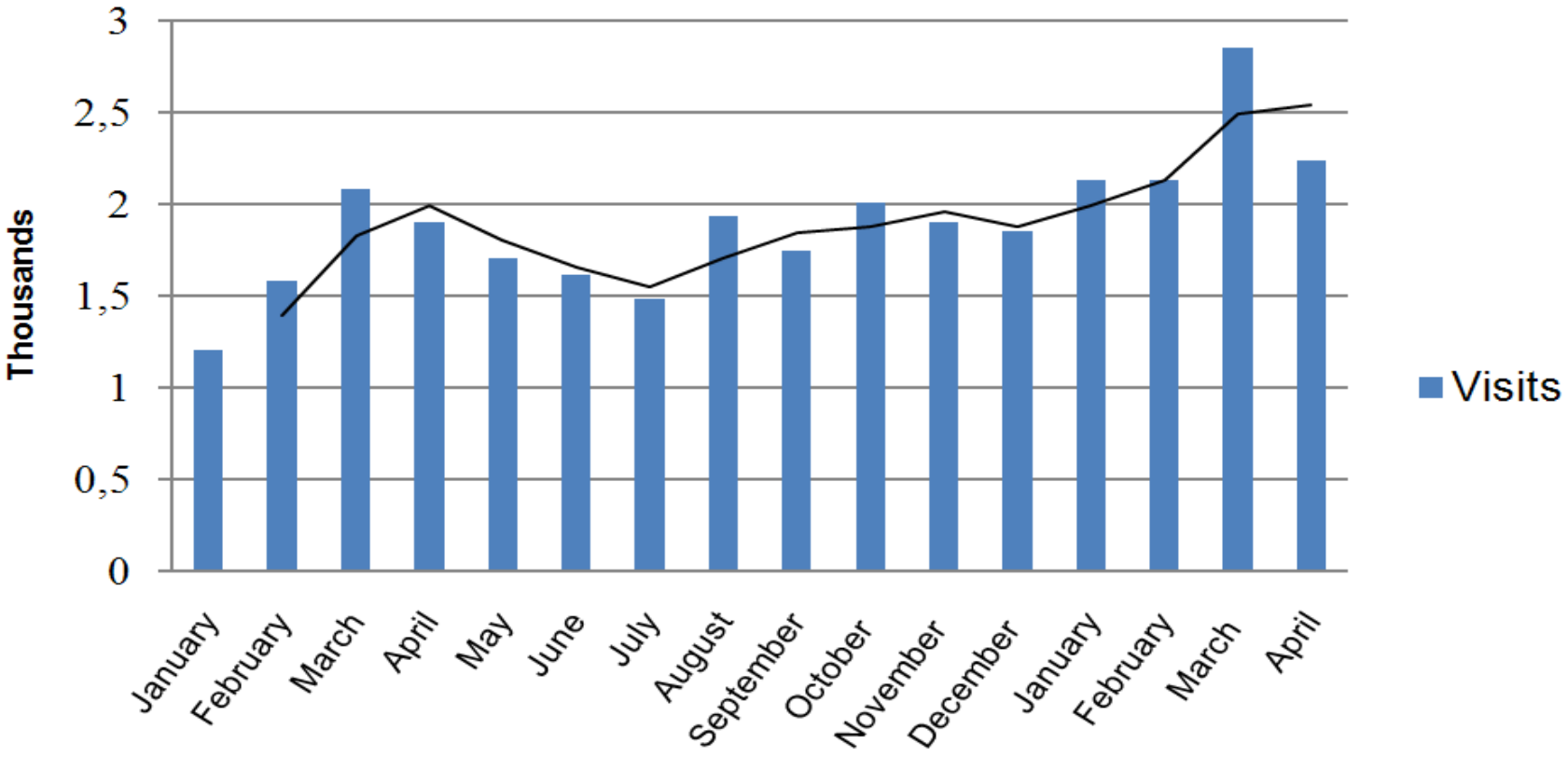


Educational background of students, who participated in the course and provided feedbacks.



Usefulness of learning elements presented as averages and standard deviations. Evaluation scale was from 1 (not useful) to 5 (very useful). A: Learning elements were available in virtual campus. Students had possibility to test them. N: Learning elements were not available in virtual campus. Students anticipated their usefulness.

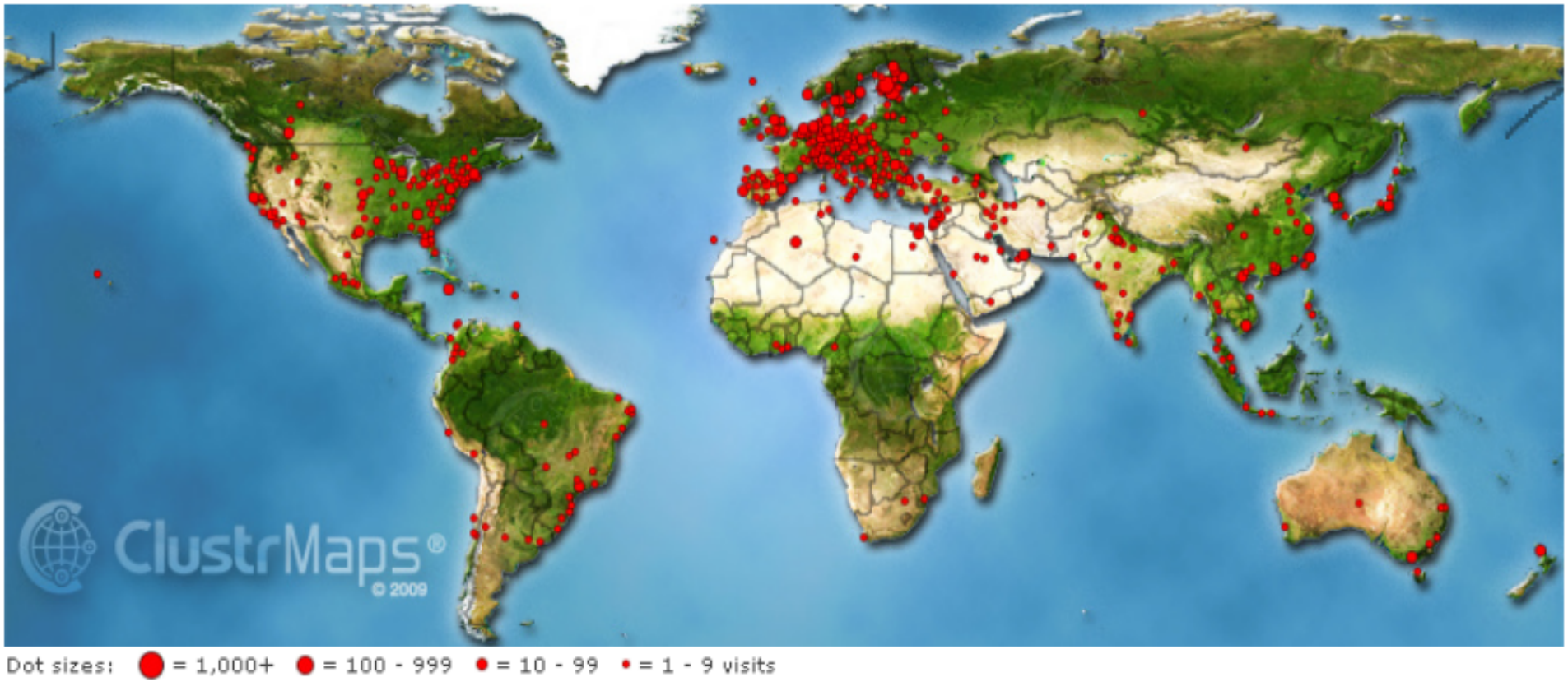
RESULTS
Web log-ins



Number of visits for each month, 2009 and January-April, 2010.

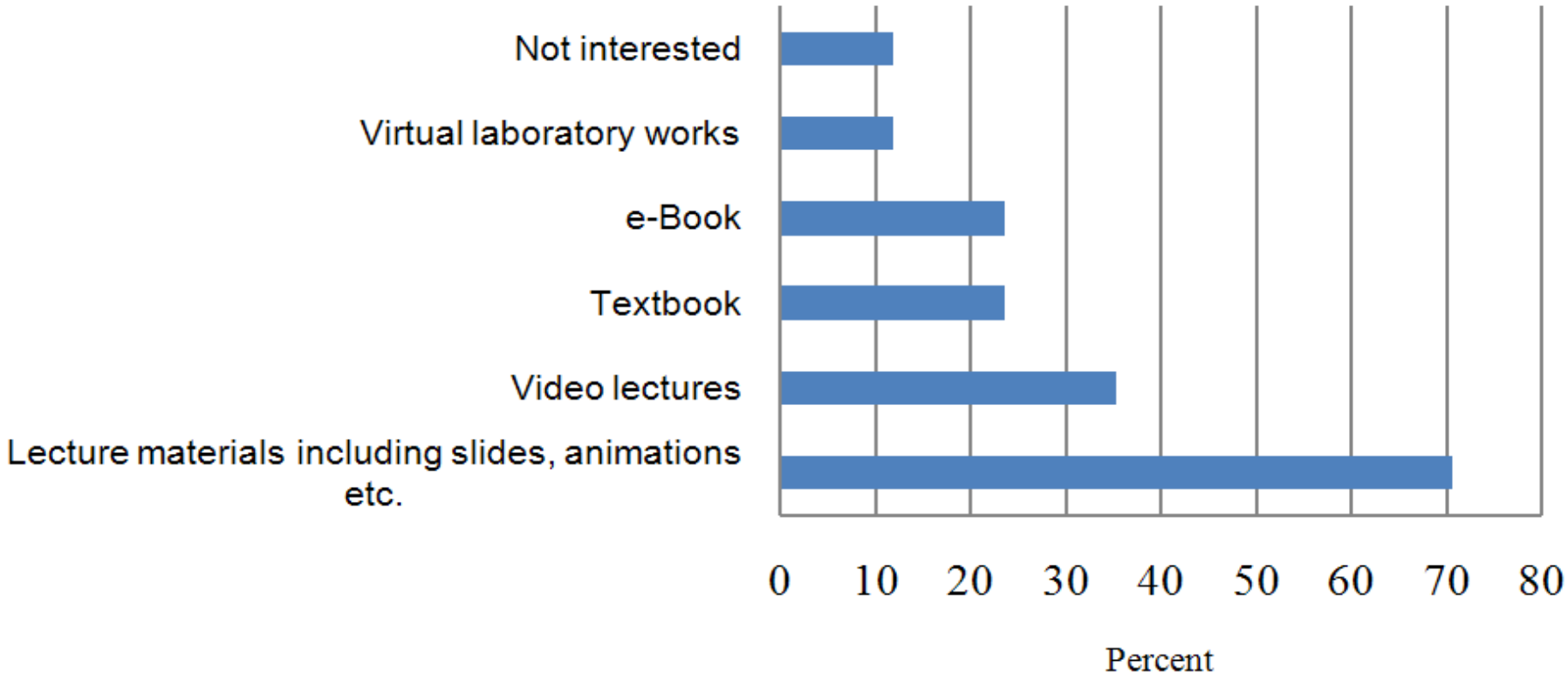
RESULTS
Web log-ins

EVICAB



From 12 Feb 2009 to 13 Feb 2010: Total: 2.958

RESULTS
Development



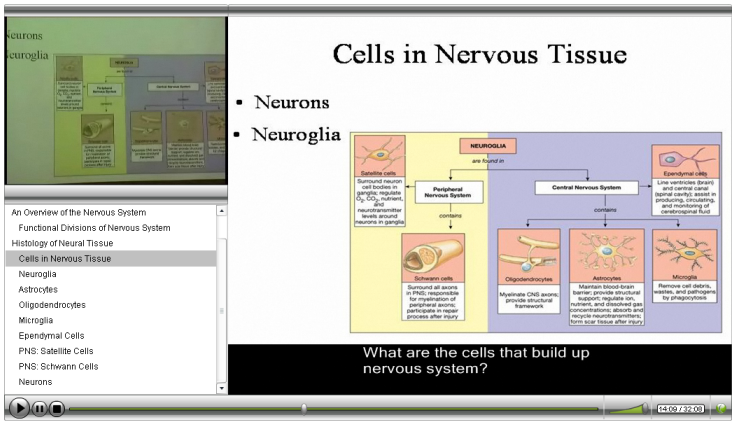
Resources that BME educators are able to provide to the virtual campus.

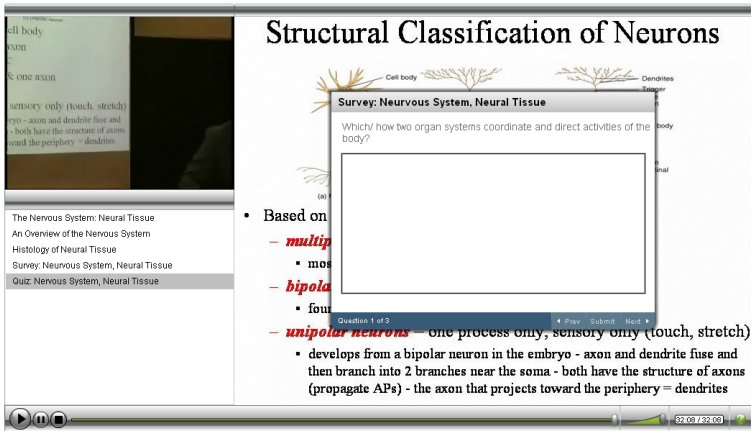
DISCUSSION

- Role of lecturer in e-learning.
- Recommended techniques for educators in e-learning.
- Learning with video lectures.
- Production team for good quality Internet materials.
- e-Learning depends on values and goals of organization.
- Virtual education:
  - Administrators
  - Instructions
  - Student recruitment
  - Technology
  - Library systems
  - ...

FUTURE IMPLEMENTATIONS

- Intelligent students' knowledge testing machine.
- Intelligent system with self-converting files for video lectures.
- Intelligent video lectures.





CONCLUSIONS

- Technologies for virtual education are available and relative user friendly.
- The main advantage of virtual education is the global open access.
- Virtual education does not replace or eliminate education on the university scale but support and augment on the global scale.
- e-Learning still support teacher-centered approach, where knowledge is unidirectional, i.e., transfered from teacher to students.
  - There is a great need for virtual laboratory works and exercises, where students could apply theoretical knowledge and develop practical skills.

THANK YOU !