Massive Open Online Courses in Microelectronics Education

Ľ. Stuchlíková, A. Kósa, P. Benko and D. Donoval

Institute of Electronics and Photonics
Slovak University of Technology in Bratislava
Bratislava, Slovak Republic
Education is radical changing

Digitize everything!

- **educational materials**
  - electronic textbooks-flexbooks, ebooks, ibooks
  - multimedia content – videos, 3D models, image galleries, interactive animations, review assessment, highlights and notes,

- **actor and content**
  - social networks and MOOCs,
  - 3D virtual worlds,
  - Augment Reality and Games,
  - digital image of Persons and content

- **educational process**
MOOC

Massive - some have 10,000s registered.

Open = free, anyone can register, being offered by elite universities through partnerships with MOOC providers

Online - designed for the participation of large numbers of geographically dispersed students

Course - designed to give students automatic or peer-generated feedback (but not necessarily accredited for anything)
Most MOOC consist of

- many short videos
  - Some talking heads
  - Some “worked examples”
  - Some experiments etc.
- on-line papers etc.
- discussion forums
- on-line activities
- formative assessments

Assessment (and feedback) will need to be

- Objective (multiple choice etc.)
- Peer review
- Self evaluation

Learning Design Workflow and Learning Analytics are central

The emphasis must be on the student as a self-motivated learner.

provide interactive user forums that help build a community for the students, professors, and teaching assistants
# The sample of MOOC Structure

<table>
<thead>
<tr>
<th>Learning Unit 1</th>
<th>Learning Unit 2</th>
<th>Learning Unit 3</th>
<th>Learning Unit 4</th>
<th>Learning Unit 5</th>
<th>Learning Unit 6</th>
<th>Up to 10</th>
</tr>
</thead>
</table>

### miniMOOCs

- have 2 or 3 Learning Units

### Weekly Learning Units:

- 2-6 hours study time
- Meaningful title, clear learning goals, end-of-unit assessment

- Each with 2 or 3 self-contained Learning Blocks

### Learning Blocks

- Sequence of elements
- (This is just one example)

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The Changing Face of MOOCs. Hugh Davis: @HughDavis. July 2013. CENTRE FOR INNOVATION. IN TECHNOLOGIES & EDUCATION. What are MOOCs?
Microelectronics education demands a wide range of knowledge with interdisciplinary studies.
Microelectronics education

Hand made experiences
Microelectronics education - Key problems

• global problem with the continuous decrease of young people’s interest in study at technical schools

• progress in innovation - necessity of constant update of the subjects’ content

• resource issues

• compressed teacher/student interaction times

• serious problem with students who came from secondary schools to universities with different level of knowledge

• lifelong education
What are the Aims, Advantages, Challenges, and Rewards of the MOOC model in Microelectronic Education?

Are MOOCs the effective answer to key problems?
The aim of MOOC (engineering education)

to combine open, high-quality courses, continuous feedback, and research

- to improve learning and transform higher education,
- to offer the best education possible to the most remote corners of the world,
- to help people further their careers and gain needed job skills
- to help people expand their intellectual and personal networks with strong student communities
The MOOC does not aim to displace conventional classroom teaching, but rather to expand the scope of educational offerings, both to new populations of learners and to users who aspire to learn in new ways. Teachers and administrators seeking to experiment with these new forms of educational opportunity hardly deserve the contemptuous disregards.
In MOOCs, we’re prepared to be wrong. On campus, people have very definite motivations and expectations, but in MOOCs, this doesn’t apply, so there is a motivation to experiment.
Barrier and MOOC

Sarah Kendzior - a critic of the academic world, looks at what this type of arrangement really means to future job seekers.

The issue that is not dealt with at all is the prestige and social rank conferred by certain universities:

MOOCs are touted for bypassing geographic and financial barriers, but they cannot replace the barrier of prestige.
MOOCs, are at the forefront of a movement to re-evaluate the traditional learning environment.

Opponents of MOOCs fear that online learning will deprive students of human interaction.

Salman Khan
American teacher - Khan Academy

- believes that MOOCs and the Khan Academy will supplement rather than supplant physical courses.
Advantages and Benefits

- **Content**: it is built and shared as the course progresses and is software agnostic.

- **Participants**: are not constrained by time or geography - people with no access to formal higher education can participate.

- **Course**: are informal and can be organized quickly. Enrolment is open to anyone, anywhere; no fee, no credentials needed. Supports career preparation and advancement of participants.

- **Own success**: Assessment for content acquisition not a priority; participant defines his or her own success.

- **Teaching**: Importing and improving teaching (global reach of instructors and topics).
Advantages and Benefits

- **Peer grading:** This way for students to practice recognizing quality work increases the amount of feedback students receive about their work and provides an opportunity for transferable skills that can be used in professional life.

- **Encouraging institutions:** To develop distinctive missions (incentivizing pedagogical change).

- **Innovative universities:** Technology today allows them to customize their education according to learning styles.

- **Helpful community:** Students can make global connections with their online peers. Students helping each other succeed even though they are on separate continents. Global networking is a plus for students and professionals alike.
**MOOC Challenges**

- **Quality and completion rates**
- **Students**: Motivation and self-regulation are key concepts and digital literacy a per-requisite.
- **Cheating is a reality. Prevent instances of alleged plagiarism**
- **Accreditation**
- **Standards and grading**
- **Drop out rate**
- **Credential models**
- **Sustainability**
Rewards for Engineering Education

There are:

- attract new learners, from broader demographic,
- lure back learners not interested in traditional courses,
- prestige,
- international reputation and also
- to make money.
What motivates the MOOC providers?

The scale and open nature of MOOCs

- provide opportunities for the expanding access to education to everyone
- creates a space for experimentation with online teaching and learning
- to improves of humankinds general life quality

significant interests from governments, institutions and commercial organizations
What motivates the universities?

- The improvement of pedagogy by refine proves teaching methods and the development of new approaches.
- To enhance university brand and allow others to experience the learning environment of their university.
- The recognized instructors and industry leaders have the ability to reach large volumes of students in ways never before possible.
- The fear of universities missing out, and being far behind in an area, that’s growing and changing as fast as these MOOCs.
What motivates the MOOC teacher?

- The most frequently cited reason was altruism - a desire to increase access to education world-wide. But there were often professional motivations too as well.

- Typically a professor spent over 100 hours on his MOOC before it even started, by recording online lecture videos and doing other preparations. Others laid that groundwork in a few dozen hours.

- Mr. Owens spent 150 hours building his MOOC, "Introduction to Parallel Programming," for Udacity. More than 15,000 people registered. Once the course started, he spent about five hours per week on it, posting frequently on the discussion forums.
Motivations for learners to participate in MOOCs are varied, and many struggle to engage with courses and keep motivated in the context of an online learning environment,

- for fun, entertainment, social experience and intellectual stimulation, convenience,
- barriers to traditional education options or to experience or explore online education
- support lifelong learning
- gain an understanding of the subject matter, with no particular expectations for completion or achievement.
MOOC and universities

MOOC is a suitable tool

- to increase the education quality
- to increase the prestige
- to make their curriculum attractive for new students and participants
MOOC in Slovakia

Slovakia is involved in the first pan-European massive open online course initiative, and has signed up to OpenupEd.

The first MOOC in Slovak language

Pre university mathematics/Introduction to Engineering Mathematics course.

It is a high-quality on-line educational material with learning objectives, study guidance and advice, intermezzos, assignments, self tests, summaries and several options for optional tutor-support, being systematically developed on Slovak University of technology from 1995.
After the boom of MOOC we decided to fully respect the MOOC platform.

Two of our portals "eLearn central journal" (http://uef.fei.stuba.sk/elearn) and "eLearn central open" (http://uef.fei.stuba.sk/moodleopen) were created by our team, as portals for the new MOOC concept.

The "eLearn central journal" has its own integrated review system and the user has to make a formal registration.

The "eLearn central open" portal is entirely free of charge and easily accessible with available interactive elearning projects without review.
Some Decisions that need to be made

How much
• to spend?
• academic time?
  • creating the MOOC
  • at run time

How to structure the course?
• pedagogic approach
• course resources
  • amount of video?
  • create new resources?
  • use OER?

How to assess?

How to give feedback?
• Video
• google hangouts
• responses to forum topics

What
• tools to use (external?)
• social media platforms to use?

How to
• deal with the fact that we can’t use the (licenced) library resources?

Ownership of Materials developed

The Changing Face of MOOCs. Hugh Davis: @HughDavis. July 2013. CENTRE FOR INNOVATION. IN TECHNOLOGIES & EDUCATION. What are MOOCs?
Currently in developing process are 9 MOOC courses:

- Introduction to semiconductors
- Electronic devices and circuits
- Display technologies
- Power MOSFET
- PN junction
- CMOS
- LED
- Photodiode
- IGBT

The course Photodiode will be prepared also in Slovak and English language, while Power MOSFET only in English. So far other courses are developed only in Slovak language.
Course
“Display technologies”

EDUCATIONAL MODULE
Display Technologies

EDUCATIONAL TEXT
Introduction
1. Cathode Ray Tube
2. Digital Light Processing
3. Electronic Paper
4. Liquid Crystal Display
5. Liquid Crystal over Silicone
6. Light Emitting Diode Display
7. Organic LED Display
8. Plasma Display Panel

CHAPTER SEGMENTATION
Introduction
Working Principle
Classification
Advantages and disadvantages
Application
Trends

Additional Information
Dictionary
Main Animation
Literature

Feedback questions
Micro-animations
Sytość farb (saturation) je dána relativnou dílkou čiary z čisté biele farby, k požadovanej farbe a priečnícikom tejto farby s bielem a geometrickým miestom. Pretože x a y sú relatívne hodnoty je potrebné zvriešť ďalší parameter pre určenie luminosencí. Označujeme ho Y a preto sa tento systém farebné charakterizácie nazýva "xyY" systém.

Aj ked CIE chromaticky diagram (obr. 3) je užitečný k znázorneniu farebného priestoru, využívať sa aj ďalšie pomocné systémy. Špecifikovanie sytosti odteňu a jasu (brightness) poskytuje spoľahlivosť na vyjadrenie farby. Pre tento model, v farebnom priestore sa využíva obratný kužel (cone) (obr. 4). Na hrane podstavy kužeľa sa nachádza spektrum viditeľného svetla v šfiovej až po červenú. Neďaleko a súčasne farba môže byť špecifikovaná na hrane v uhte na podstave kužeľa začínajúc na farbe červená-0 až do 360 alebo činné hodnotami (0-255). Sytość farby je čistota farby a vyjadruje sa v percentách alebo 8-bitovým číslom od stredu podstavy (min.) po hranu (max.). Jas je takisto vyjadrený precentuálne alebo 8-bitovým číslom z čiernej (min.) k bielem (max.), ak je jas = 0 obe aj sytość aj odteni sú bezvýznamné.

Obr. 4 Systém odteňa (H), sytosti (S) a jasu (V) určite farby

? Co sa stane ak je jas = 0 ?

Hlásť odpoveď
3.9. Remove sidewall spacers and implant the NMOS lightly doped source/drain
At present developed courses are in the process of review or published as open online courses.

After course finalization according to the defined criteria of MOOC quality they are going to be subscribed to the OpenupEd and published as an MOOC.

The first of these MOOC courses are going to be exported with high probability during this year.
Conclusion

Microelectronics education demands a wide range of knowledge with interdisciplinary studies, therefore it faces big challenges, from resource issues, decrease of interest, progress in innovation, and lifelong education to compressed teacher/student interaction times.

MOOCs are here to stay and evolving rapidly and have huge potential to be an answer to some of these issues.
Conclusion

• Video Lectures, Supplementary Materials, Surveys, Homework Assignments, Gradings and Logistics, Discussion Forums, Joining Meetups, Help Articles - standard parts of quality MOOCs are an incredible support and motivation tools for study.

• Many of MOOCs are being taught by professors at prestigious universities, what can be a very interesting experience for students from all over the world.

• MOOC attraction is free, being offered by elite universities through partnerships with MOOC providers and is opened to anyone with an Internet connection.

• Even if the MOOC model has many unanswered key questions, it is a very efficient way to increase the quality and diversification of education.
Thank you for your attention!

lubica.stuchlikova@stuba.sk

If we teach today’s students as we taught yesterdays, we rob them of tomorrow.

John Dewey (1859-1952)

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"Future educational challenges in electrical engineering education: Will MOOCs be a threat or an opportunity?"

Ľ. Stuchlíková

Institute of Electronics and Photonics
Slovak University of Technology in Bratislava, Slovak Republic
e-learning

cooperative learning

tutor-based telelearning

remote and virtual laboratories

ubiquitous/mobile learning

massive open online courses

virtual collaboration/classrooms

3D virtual worlds

multimedia learning

simulations

study supports with internal intelligence

games

millennials

microlearning
many people see MOOCs as providing opportunities to learn in difficult STEAM (Science, Technology, Arts & Design and Mathematics) fields.

They are confident that MOOCs are providing students with a better online education experience, more opportunities for socialization and collaboration - this is in harmony with the effort of society to be successful and enhances the focus on quality of education.
Universities using MOOC support

- the opportunity that MOOCs offer for massification of courses spoke to governments, institutions and commercial organisations
- a number of bespoke MOOC platforms have been developed and offer courses independent of or in collaboration with universities
  - are listed in the record of Top Universities

<table>
<thead>
<tr>
<th>Order in university rankings 2013</th>
<th>Title of university</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>Harvard University</td>
</tr>
<tr>
<td>7</td>
<td>Stanford University</td>
</tr>
<tr>
<td>10</td>
<td>Princeton University</td>
</tr>
<tr>
<td>13</td>
<td>University of Pennsylvania</td>
</tr>
<tr>
<td>22</td>
<td>University of Michigan</td>
</tr>
<tr>
<td>25</td>
<td>University of California, Berkeley</td>
</tr>
<tr>
<td>37</td>
<td>University Wisconsin</td>
</tr>
<tr>
<td>44</td>
<td>University of New York</td>
</tr>
<tr>
<td>52</td>
<td>University of New South Wales</td>
</tr>
<tr>
<td>71</td>
<td>University of Texas at Austin</td>
</tr>
<tr>
<td>127</td>
<td>University of São Paulo</td>
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<tr>
<td>132</td>
<td>University of Virginia</td>
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<tr>
<td>171</td>
<td>University of Michigan</td>
</tr>
<tr>
<td>279</td>
<td>University of Queensland</td>
</tr>
<tr>
<td>304</td>
<td>University of North Carolina</td>
</tr>
</tbody>
</table>
MOOC in the field of engineering education

<table>
<thead>
<tr>
<th>Provider of MOOC</th>
<th>Title of course</th>
</tr>
</thead>
<tbody>
<tr>
<td>Canvas Network</td>
<td>Intro to Sustainable Energy Clemson University</td>
</tr>
<tr>
<td>Canvas Network</td>
<td>Sustainable Energy Innovation Clemson University</td>
</tr>
<tr>
<td>edX</td>
<td>Courses in the category of Electronics</td>
</tr>
<tr>
<td>edX</td>
<td>Courses in the category of Engineering</td>
</tr>
<tr>
<td>Coursera</td>
<td>Introduction to Power Electronics</td>
</tr>
<tr>
<td>Class2Go</td>
<td>Solar Cells, Fuel Cells, &amp; Batteries</td>
</tr>
<tr>
<td>Khan Academy</td>
<td>Discovery of Electromagnetism</td>
</tr>
</tbody>
</table>
Unanswered Questions

the biggest question surrounding MOOCs is how they might integrate with the current credentialing infrastructure in a way that makes college degrees less expensive?

Will elite universities offer transferable credit or full credentials for MOOCs?

Will proprietary MOOC platforms gradually give way to open source solutions?

Will MOOCs address the challenge of expanding education in the developing world?
Unanswered Questions

Will working adults see MOOCs as an alternative to professional education courses?

Will employers accept MOOC certificates as evidence of relevant skills?

Will traditional undergraduates consider virtual courses an alternative to a residential experience?

The rapid expansion of MOOCs has sparked commercial interest from venture capitalists and major corporations who want to enter the High education market using a MOOC approach?
How do MOOCs make money?

- Certifications
- Authenticated assessments
- Human tutoring
- Corporate learning
- Sponsorship
- Access to student records
Thank you for your attention!

lubica.stuchlikova@stuba.sk