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for Information Technologies
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Futures for Higher Education and ICT: Changes Due to the Use of Open Content



Futures for ICT and Higher Education: Changes Due to the Use of Open Content

UNESCO Institute for Information Technologies in Education

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Preface

As we move towards 2030 bearing in mind the Sustainable Development Goals, we must address the challenges faced by education due to the fast changes in society, economy, and technologies. This publication presents the results of the project “Access, Equity and Quality: Envisioning the Future of Higher Education in a Digital Age” implemented by the UNESCO Institute for Information Technologies in Education (UNESCO IITE) in 2014-2016. The project was aimed to identify the current trends related to the use of open and online education and to bring evidence to the debate about the future changes expected due to the use of new approaches to teaching and learning, new technologies and new forms of content developed for higher education (HE). The project mobilized existing think tanks to determine the future agenda for information and communication technologies (ICT) in postsecondary education and to contribute to shaping education policies based on research and foresight studies conducted by UNESCO IITE in collaboration with its partner-institutions.

The project addressed the following main issues: future learning contexts for open content; future curricula; futures of learning credentials and validation; the future role of teachers and faculty; and changing role of HE institutions. Exploration of these and other issues helped develop a better understanding of how postsecondary education might evolve in the future and start thinking about the scenarios that are preferred to shape the system of higher education that would contribute to the realization of the Sustainable Development Goals.

The project employed a forward-looking approach to analysing the impact of various contemporary trends on higher education and a mixed research method, which included comprehensive desk research, trends analysis, qualitative study based on brainstorming, focus groups and an online survey for policy makers at national and international levels and for representatives of universities. The report discusses the trends and prospects regarding the changes related to the use of ICT both from quantitative and qualitative standpoints. It examines in particular the link between these developments and the need to rethink the role of the academic profession and higher education policy.

We believed it vitally important to include the opinions of key stakeholders from more than 50 countries who gave significant input on the changes provoked by the rapid advancement of technologies, on current practices and trends and their vision of the future changes that might occur in higher education due to wide distribution of Open Educational Resources (OER) and Massive Open Online Courses (MOOC).

We hope that the results of this project will be of value and interest to universities and policy makers alike and to the growing number of wider stakeholders involved in the sector. Being a record of our analysis and joint thinking, this publication is also an invitation to debate the issues raised and discussed not just about the future that we expect for the higher education and ICT, but also the future we chose to create.

Executive Summary

This publication presents the outcomes of the activities undertaken within the project “Access, Equity and Quality: Envisioning the Sustainable Future of Postsecondary Education in a Digital Age” initiated by the UNESCO Institute for Information Technologies in Education (UNESCO IITE) in 2014. The project was aimed to strengthen UNESCO’s function as an international laboratory of ideas capable of rethinking education and a platform for the global debate and reflection on critical emerging trends and challenges. The project mobilized existing think tanks to determine the future agenda for information and communication technologies in postsecondary education and to contribute to shaping education policies based on research and foresight studies conducted by UNESCO IITE in collaboration with its partner-institutions: EDUCAUSE, the International Council for Open and Distance Education (ICDE), the International Federation for Information Processing (IFIP), the New Media Consortium (NMC), Skoltech, and universities from many countries of the world.

To identify how the changes in technological, social and economic contexts impact postsecondary education and derive the key implications for decision and policy makers at national and institutional levels the following questions were raised within the project: How will higher education evolve over the next 15 years? How might technological changes impact the society, labour market needs, higher education systems and institutions? What opportunities and challenges do they imply? How can and do countries and institutions address these changes? In what ways are the skills required by the market changing? How should higher education institutions (HEI) adapt to the changing learning needs? What impact will the availability of new technologies and online resources have on how people learn? Are national systems of recognition of learning outcomes and credentialing prepared to accommodate the results of open education? Will the system of higher education develop towards open online learning or campus-based learning?

The mixed-method research study comprised comprehensive desk research, trends analysis, qualitative study based on brainstorming, focus group discussions and an online survey designed for policy makers at national and international levels and representatives of universities. Foresight as a method to think, debate and shape the future was an essential part of this project. An important outcome of the survey is the comments provided by key stakeholders on current practices and the trends and their vision of the future changes expected in higher education due to wide distribution of Open Educational Resources and Massive Open Online Courses.

The project activities were based on solid base of data and consultation:

- A desk study of the literature about future and foresight reports pertinent to the relationship between higher education (HE) and information and communications technologies;
- An analysis of the trends that might have significant impact on the future of higher education;
- A series of high-level expert workshops organized to design the concept of the project, further elaborate the results of the desk study and trend scan and to determine, test and prove critical topics for the survey;

- An online survey designed for experts in ICT and higher education and high-level decision makers.

The literature study provided a comprehensive overview of the major challenges that higher education faced and would face as a consequence of the rapid technology-induced changes not only in education, but also in the society and economy. In parallel to the literature study, to analyse the impact of various contemporary trends on postsecondary education, a literature-based trend/issue analysis was performed across the so-called STEEP dimensions – the impact of social, technological, economic, environmental and political changes on student enrolment, educational achievements, academic staff and policy choices. Drawing on trend analysis, a total of 42 trends/issues were identified and described (Van Rij, 2015-1).

The online survey launched at UNESCO IITE website was ocused on the following topics:

- Future learning contexts for open content
- Future curricula
- The future of validation of learning outcomes
- The future role of teachers and faculty
- The changing role of HE institutions

The survey revealed an urgent need for revision of HE curricula and for capacity-building of teaching and support staff to enable them to use open digital resources. Furthermore, the survey identified the need to rethink the ways the OER/MOOC-based learning results are recognized and validated.

Consultations with experts in the field of educational foresight, ICT and higher education were organized at different stages of the project. The topics of the survey were formulated during the expert workshop held in March 2015 in Paris, the questionnaire was tested at the International Conference for UNESCO/UNITWIN Chairs in ICT and Innovative Pedagogy “UNESCO Chairs Partnership on ICT Use in Education” held in June 2015 in St. Petersburg and launched during the high-level meeting “Online, Open and Flexible Higher Education for the Future We Want” held in June 2015 in Paris.

Having analysed the current changes and emerging trends in the development of the society and economy and surveying the opinions of key higher education stakeholders, this study has revealed the visions and expectations of decision makers and educators with respect to the changes in the mission and functions of higher education institutions, modes of teaching and learning, pedagogical approaches, student-teacher relationships and the role of teachers, as well as the challenges and opportunities brought by the use of ICT and open content (OER an MOOC). Within the next 15 years, they expected higher education to become less elitist and more open, tailored far more to the requirements set by the society. Open content will become an integral part of the teaching and learning processes. Due attention should be paid to the quality of educational resources and learning outcomes, assessment and recognition of OER/MOOC-based results. These issues are closely related to the revision of the system of credentialing, including the transfer of credits and introduction of microdegrees. Operating as lifelong learning institutes, universities are expected to provide content facilitation and skill development using personalised blended learning approaches and to enable joint production of knowledge with engagement of students.

The results of the project are meant to raise awareness of higher education stakeholders such as policy makers, managers of higher education institutions, academics, researchers and students, as well as of all readers interested in social issues.

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UNESCO IITE would like to thank all the respondents who contributed information to this study and took the time to complete the online survey, which formed the basis for the conclusions made in the report.

Introduction

Aims of the project

This project was aimed to strengthen UNESCO's function as an international laboratory of ideas capable of rethinking education and a platform for the global debate and reflection on critical emerging trends and challenges in order to determine the future agenda for information and communication technologies in postsecondary education and to contribute to shaping education policies for Education-2030 based on research and foresight studies conducted by UNESCO IITE in collaboration with its partner-institutions.

The introduction of new technologies and forms of content in the teaching and learning process increasingly impacts higher education. To ensure that Member States can cope with and benefit from future changes, the project was intended to provide a comprehensive and structured look at the challenges and opportunities brought by the use of ICT and open content (OER and MOOC) in higher education through both quantitative and qualitative analysis.

Definitions

The following definitions of Open Educational Resources and Massive Open Online Courses were used in the study:

OER refers to any educational resources (including curriculum maps, course materials, textbooks, streaming videos, multimedia applications, podcasts, and any other materials that have been designed for use in teaching and learning) that are openly available for use by educators and students, without an accompanying need to pay royalties or license fees (Butcher, 2011). OER can exist as smaller, stand-alone resources (reusable learning objects), that can be mixed and combined to form larger pieces of content or as larger course modules or full courses. OER can also include simulations, labs, collections, journals, and tools. These materials are considered open if they are released under an open license such as a Creative Commons license.

Massive Open Online Courses (MOOC) are online courses designed for a large number of participants that can be accessed by anyone anywhere, as long as they have an Internet connection. They are open to everyone without entry qualifications and offer a complete course experience online for free. They are led by subject matter experts from higher education or industry and hosted by learning management systems or dedicated MOOC platforms (Witthaus et al., 2016).

It is clear that while reasoning about OER and MOOC within this project educators and policy makers might have left out certain important aspects of the definitions, for example, their openness (including licenses) or scope (the numbers of registered students). However, it was supposed that the terms were considered and used by the experts or respondents in their proper sense; otherwise one could suggest that their replies were referred to online educational materials, which does not diminish the conclusions of the report.

Methodology

Decision makers use future projections and/or visions together with experience and knowledge about the past to support decision-making process. They can do this intuitively but also with the help of the so-called forward-looking methods, such as forecasting and foresight, which rationalize the future projections and vision building in a systematic and transparent way.

Forecasting entails planning and quantitative analysis and is very commonly used to prepare important decisions especially if they are concerned with large-scale investments. Usually the analysis is based on statistical data, which is projected into the future. Nowadays, this projection is done with either sophisticated models or the use of scenarios where policy measures are tested with the use of quantified input and output parameters. In educational policy, this might be quantitative indicators of expenditures, the number and level of qualification of teachers, the number of students in certain age groups, the outcomes of PISA scores, the number of degrees at different levels, etc. These approaches were used in the reports “Trends in Global Higher Education: Tracking an Academic Revolution” prepared for the UNESCO 2009 World Conference on Higher Education (Altbach et al., 2009) and the report “Trends Shaping Education” developed by OECD (2013).

Foresight is less focused on forecasting but can use the results of forecasting to feed its processes. In general, foresight tries not only to quantify important aspects of the phenomenon/process under exploration, but also to stimulate the debating on the future (using all available knowledge but also imagination) to activate relevant stakeholders and let them shape the future to their will within the existing constraints that might have been set in the past. Foresight, therefore, is often considered as a process rather than a product. In this process, participative methods prevail with a focus on the sharing of knowledge and the fostering of creativity. Foresight as a method to think, debate and shape the future was an important part of this project.

Foresight methods bring together relevant stakeholders and experts to think and debate the future and to create common visions or to develop more qualitative scenarios, which sometimes are translated into more quantitative models. Good examples are the “Beyond Current Horizons” exercise completed by the UK Department of Schools, Children and Family (Facer, 2009) and the “Future of Learning” exercise conducted by the Institute for Prospective Technological Studies (IPTS) of the Joint Research Centre of the European Commission (Redecker et al., 2011).

The process of foresight can employ different techniques to gather information or to visualize the outcomes: the construction of scenarios, horizon scanning, vision building, road-mapping, back casting, a Delphi survey, a weak signal search, a wild card approach, citizen or expert panels, etc. An overview of these techniques can be found in numerous handbooks, for example, UNIDO “Technology Foresight Manual” (UNIDO, 2005), “Handbook of Technology Foresight” (Georghiou et al., 2008), the guidance document of the UK Government “The Futures Toolkit” for policy makers and analysts (HM Government, 2014), “A Practical Guide to Regional Foresight” (FOREN, 2001), etc.

Among other foresight techniques, the project employed the Delphi method, which is used to facilitate the establishment of consensus among experts on predictions concerning specific issues. It follows a structured and iterative process and suggests the analysis of previous responses, while the participants are allowed to modify and adapt

their statements. This usually leads to a consensus on future trends and promotes scenario development.

Horizon scanning method is used to identify the early signs of potentially important developments through a systematic examination of potential threats and opportunities. The technique reveals new and unexplored issues, as well as permanent problems and trends. It is often based on desk research that involves a wide variety of sources.

Trend impact analysis extrapolates historical data into the future, but may also consider unprecedented future changes. It allows for inclusion of the effects of possible future changes that are expected to have an impact on extrapolated trends. Expert opinions are used to reveal future events that might cause deviations from the projection and calibrate their likelihood and potential impact.

A mixed research approach method was used in the project. The project activities were arranged in four stages, including a review of academic and grey literature and an in-depth trends analysis at the preparatory stage, consultation with experts and stakeholders and an online survey. Stakeholders were involved in discussion of major issues and revision of the outcomes of the first two stages, while at the last two stages they were directly involved in constructing preferred futures.

At the preparatory stage, a desk study, the so-called STEEP analysis, was conducted to identify social, technological, economic, environmental and political factors that are expected to impact the future needs, possibilities and challenges in the area of ICT and higher education. The desk study was primarily literature-based. It summarized conclusions and considerations from a wide range of foresight activities and the works of future thinkers and think tanks aimed to envision the future development of the relationship between ICT and higher education. The future development of this relationship is intertwined with societal, economic and political changes and can only be understood in this wider context. Therefore, in addition to the focus on the future instrumental role of ICT in higher education, the study also considered the dynamic co-evolution of learning and teaching together with future societal, economic and political changes that are interacting with ICT developments.

Major trends relevant to thinking about the future, debating and shaping the future development of HE in relation to ICT were mapped and assessed, and later discussed at expert workshops. The discussion at the high-level expert workshop held in March 2015 was triggered by a paper that contained a summary of the different lines of foresight (Van Rij, 2015-1) related to higher education and ICT, a trend analysis (Van Rij, 2015-2) and an overview of the development of new educational technologies (Butcher, 2015).

For the online survey, the questionnaire was formulated on the basis of the outcomes of the discussion held during the high-level expert workshop. The questionnaire was designed by UNESCO IITE experts and staff. It was tested during the UNESCO IITE Conference of UNESCO/UNITWIN Chairs in ICT in Education and Innovative Pedagogy “UNESCO Chairs Partnership on ICT Use in Education” and discussed with a wider group of experts at several events dated to large-scale conferences on ICT in education. The online survey contained open- and close-ended questions. The answers to open-ended questions provided further clarification of the answers to the close-ended questions and basic information for the planned virtual foresight focus groups. Experts in the

field of ICT, higher education and educational foresight and decision makers in higher education were invited to complete the online survey.

Analysis of the survey data was oriented towards the identification of crucial aspects of the mid- and long-term impact of ICT on postsecondary education, in particular, the lines of vision of the respondents on the future of open content, recognition of OER/MOOC-based learning results, curriculum revision, needs for teacher training in view of future changes in the role of teachers and the whole higher education ecosystem. Conclusions were drawn on the basis of the key outcomes of all stages of the project and summarized the insights on the preferred changes and the future.

Literature study

The research on thinking and debating on the future relationship of ICT and higher education was based on the analysis of recent foresight exercises and the results of activities of a variety of think tanks dealing with ICT in higher education. Most of these activities focused on the instrumental role of ICT to improve the existing educational practices. In addition, the activities and documents focused on the impact of ICT on society and economy and its implications for social and economic demand for ICT skills were explored. Finally attention was paid to the trends that were mentioned in the foresight exercises and the expectations towards the shorter and longer term impact of some emerging ICT applications and technologies for higher education.

The literature study focused on the main topics discussed in the literature on the future and foresight relevant to higher education and ICT:

1. ICT in relation to the development of knowledge society and knowledge-based economy.
2. The future of work and skills to be acquired at postsecondary education level.
3. The future of higher education.
4. The future of ICT in higher education.

Knowledge society and knowledge-based economy

The concept of “knowledge society” was introduced during the 1960s and 1970s. It has been lively debated during the last decades. UNESCO in its report “Towards Knowledge Societies” (UNESCO, 2005) adopted the concept of the knowledge society, which has been gradually evolving since then.

Education and learning, both formal and informal, have a central part to play in developing Knowledge Societies. ICT, including the Internet, have opened up new possibilities for everyone, whether in school or lifelong learning, to access information, ideas, curricula and tools that previously were unavailable to them. Distance learning can bring higher standards of education to remote and underserved communities. ICT can put learners themselves at the centre of the educational experience, developing their own knowledge and skills with the support of teachers and others in their networks. Their ability to develop information into knowledge, and knowledge into activity and innovation will be critical to the potential of Knowledge Societies to enable prosperity, inclusiveness and sustainability (UNESCO, 2015).

The concept of “knowledge-based economies” was coined by OECD: *economies which are directly based on the production, distribution and use of knowledge and information.*

According to the OECD report, *the advent of the knowledge-based economy raises questions about the efficiency and equity of education and training in what must also be a “learning economy”* (OECD, 1996).

These concepts are dealt with in the literature in a descriptive or normative ways. They force us to rethink *what and how we should learn but also how “earning” will be generated in knowledge and learning societies, what kind of work will evolve and what kind of skills will be needed to live in future societies. This rethinking will lead to different outcomes in different countries and should be done in participatory processes in each country* (Holler et al., 2014).

The European Commission’s large-scale foresight exercise “Future of Learning” completed by the Joint Research Centre’s Institute for Prospective Technological Studies (Redecker et al., 2011) concluded: *Technology has catapulted us into a knowledge based, global society. It is clear that success in this society will require significantly different skills than in the past* (CEO Forum, 2001; International ICT Literacy Panel, 2002).

The future of work and skills

The knowledge society will require a multitude of complementary 21st century skills, all of which express high expectations towards the future generation of competitive entrepreneurs, creative and communicative problem-solvers addressing present and future major global challenges.

The European Commission “Future of Learning” online consultation on new skills for future jobs built a vision for education and training policy that would adequately prepare learners for life in the future society, envisaging which competences will be relevant and how these will be acquired in 2020-2030, in particular with the use of technologies. Its starting point was the study on future learning spaces (Punie and Cabrero, 2006; Punie and Ala-Mutka, 2007; Miller et al., 2008). The final report of the exercise emphasized the shift from classical learning to personalized learning: *To fully realize the educational opportunities that 21st century skills can bring to students, education leaders must formally incorporate them into the mainstream of school curriculum, instruction, and assessment.*

In 2010, the participants of a workshop held within the Blue Skies Project “FarHorizon” concluded that *the development of ICT in the last decades doubtlessly ranks amongst the major revolutions in our ability to communicate and to manage information. Former major revolutions in the sphere of human communication include the development of speech in prehistoric times, the development of handwriting and later the invention of printing. Each of these revolutions has had a tremendous impact not only on the way we lived, hunted, worked and produced, but also on how and what we learned* (Van Rij and Warrington, 2011). The report stated that it was not only necessary to incorporate the full array of ICT in all curricula to help students acquire the skills they need for work and life, but also to stimulate the use of ICT to discover, create and innovate.

The Cedefop report (2010) provided an analysis of the ways in which the demand in different professions might change over time. The prediction was quite optimistic for high-skilled professions as “legislators, senior officials and managers”, “professionals”, “technicians”, “service shop and sales workers” and pessimistic for “clerks”, “craftsmen” and “skilled agricultural and fishery workers”. In general, it was expected that in Europe

the demand for high- and medium-skilled labour will grow, which will be compensated by declining demand for low-skilled jobs.

Most 21st century skill lists include ICT and ICT-related skills, which are mentioned but often hidden in overarching and more abstract descriptions of skills. The debates about the future stressed the importance of critical thinking, entrepreneurship, creativity and other problem-solving skills with implicit or explicit reference to ICT skills (Engauge, 2013; Hannover Research, 2011; Partnership for 21st Century Skills, 2008; UNESCO, 2012; UIL, 2012; UK Commission for Work and Skills, 2014). Below all aspects related to 21st century skills are listed in decreasing order of frequency they are mentioned in the studies:

- Collaboration and teamwork
- Creativity, imagination
- Critical thinking
- Problem solving
- Flexibility and adaptability
- Global and cultural awareness
- Information literacy
- Leadership
- Civic literacy and citizenship
- Oral and written communication skills
- Social responsibility and ethics
- Technology literacy
- Initiative
- Curiosity and inquisitiveness
- Financial literacy
- Health and wellness
- Media literacy
- Productivity
- Accountability
- Entrepreneurialism
- Information analysis
- Basic literacy
- Contextual learning
- Environmental literacy
- Interpersonal skills
- Metacognition
- Visualization skills

In the report on youth unemployment, the Institute for the Future (2014) tried to summarize these challenges and developed four scenarios: forced flexibility, the great divide, skills activism and innovation adaptation. The report of the UK Commission for Work and Skills “The Future of Work, Jobs and Skills in 2030” (2014) predicted the development of market-based and employer-focused education. The report mapped

the main trends foreseen for the coming decades and designed four scenarios with characteristics similar to those of the Institute for the Future.

The future of higher education

Higher education faces many challenges, which makes the topic of its future hot. Its perspectives have recently been discussed by many fora, national think tanks and international interest groups and media. Many of these discussions were focused on the strategic choices that universities have to make in a competitive world, which faced the increasing number of competitors from the emerging economies and created a growing world market for higher education.

The European Commission “Future of Learning” report also stressed the additional and enabling value of ICT for education as follows: *ICT will change what, how, where and when people learn. Due to the ubiquity of technology and its power to facilitate highly dynamic, adaptable and engaging virtual learning environments, personalized lifelong learning opportunities will become feasible. ICT will enable teachers to better respond to diversity and heterogeneity in the classroom and to adapt learning material and objectives to individual students’ learning needs. ICT will furthermore support lifelong learning opportunities that smoothly integrate into people’s lives and allow them to adapt their training objectives, schedule and pace to individual needs and preferences.* The report recommended educational and training institutions to promote *tailor-made collaborative learning opportunities that are adaptable, challenging, relevant and enjoyable, open access and basic digital skills need to be fostered.* The report recommendations were extended to policy makers who would need to *ensure that all citizens will be able to benefit from the opportunities offered and that more vulnerable groups are equipped with the necessary skills to participate in learning activities that are more and more technology based* (Redecker et al., 2011). Finally, it was concluded that teachers and trainers needed targeted training, enabling them to align pedagogy and technology to the benefit of their learners.

The scheme of a recent exercise for Australian universities (Ernst & Young, Australia, 2012) specified a set of main drivers that were representative of many higher education systems in the developed countries. The horizon scanning report followed the conclusions of the British Council (2012) regarding the mobility market and foresaw a strong impact of MOOC and online learning on the universities, which would bring in new players and alliances and cause resistance of students (who prefer blended learning).

Higher education institutions (HEI) try to find a way to respond to new challenges, including quality issues, growing number of students and the current change of the educational paradigm, which urges them to revise their mission and functions (Coiffait, 2014; Rathenau, 2014). Liberalization, which created the context for the rapid expansion of cross-border activities in higher education (British Council, 2012) and facilitated the conceptualization of HE as a tradeable commodity and the demand for further privatization, is one of the strongest drivers of change.

Another aspect that urges universities to revise their role and function is the rapidly changing technology that starts creating a kind of automation process for (massive) education and research (Noorden, 2014), which might not only reduce production costs (Deming, 2015; Ruth, 2012) but also allow many other players to enter the market, which basically undermines many of the stable pillars of 19th and 20th century universities: a

monopoly in awarding degrees, the society-wide recognition of the high-quality expertise, etc. (Barber, 2013; Educause, 2010; Ernst & Young, 2009; The Economist, 2014-2).

The future of ICT in higher education

The relationship between ICT and higher education can be considered from the instrumental perspective and from the substantive perspective. The instrumental perspective suggests pedagogic and catalytic rationale (implementing educational change to improve the educational process) and the cost-effectiveness rationale (cost reduction), while the substantive perspective involves the social and vocational rationale, incorporating ICT fluency as a learning objective in curricula (Van Rij and Warrington, 2011).

“The Future of Higher Education: Beyond the Campus” report (Educause, 2010) emphasized the cost saving aspects of new ICT developments (cloud computing in combination with mobile devices and open educational resources, etc.), but also stressed the importance of identity management and learning analytics for managerial purposes, as well as the value of collaboration tools for preparing students for their future working environments.

The New Media Consortium “Horizon Report: 2015 Higher Education” incorporated the consensus view on the technologies, which would have a significant impact on the practice of higher education around the globe and discussed some of them more in depth. It also identified a set of trends and challenges for the higher education system in the coming decade. The report mentioned the following key trends accelerating technology adoption in higher education:

- Long-Term Trends (five or more years)
 - Advancing cultures of change and innovation
 - Increasing cross-institution collaboration
- Mid-Term Trends (three to five years)
 - Growing focus on measuring learning
 - Proliferation of open educational resources
- Short-Term Trends (one to two years)
 - Increasing use of blended learning
 - Redesigning learning spaces

The report described solvable (blending formal and informal learning), difficult (personalizing learning, teaching complex thinking) and wicked (competing models of education, rewarding teachers) challenges impeding technology adoption in higher education. Among important developments in educational technology for higher education for different time-to-adoption horizons the report suggested: for one year or less – Bring Your Own Device and flipped classroom, for two to three years – makerspaces and wearable technology, for four to five years – adaptive learning technologies and The Internet of Things.

The enormous learning space created by the Internet and ICT, including the Internet of Things, requires a different approach to education and a focus on “learning to learn with the available and developing technologies”, especially in open spaces (Prensky, 2001; Levin, 2002; Wheeler, 2015). ICT and the Internet of People and Things create an optimized environment for personalized but also informal learning. The increasing speed of technological change should be continuously taken into account in curriculum

development both by teachers and learners (Prensky, 2014; Van Rij and Warrington, 2011).

The intensive development of online courses and new opportunities to learn online autonomously might challenge the world of formal education degrees. Although the concerns of universities in developed countries occupy a great deal of discussion space on the Internet, they are few compared to the concerns of developing countries that are building up their tertiary education systems to comply with the increasing number of students and growing need for engineers and scientists (iResearch, 2014; Inamorato dos Santos, 2011).

Trend analysis

In parallel to the literature study, a literature-based trend/issue analysis was performed across the so-called STEEP (social, technological, economic, environmental and political) dimensions. In total, 42 trends/issues were identified and described (Van Rij, 2015-1).

1. Social (including demographic) trends
 - 1.1 World population growth
 - 1.2 Ageing population in developed countries; increasing share of younger population in developing countries
 - 1.3 Rising demand for higher education: regional differences
 - 1.4 Intensification of international mobility of students
 - 1.5 New-generation students learn differently
 - 1.6 The new balance between leisure and work
 - 1.7 Long-distance interconnectivity and collaboration
 - 1.8 New balance of virtual and real life
 - 1.9 Creating the personal “cloud”
 - 1.10 Machines as colleagues
2. Technological trends
 - 2.1 Fast unpredictable change of technologies
 - 2.2 Increasing access to Internet worldwide but digital divide remains
 - 2.3 Increasing role of open distance learning in growing economies and for remote areas
 - 2.4 Increasing number of MOOC
 - 2.5 The law of Moore
 - 2.6 Big data and the cloud: exponential increase of all ICT-enabled opportunities
 - 2.7 Visualization, augmented reality, simulation and gamification
 - 2.8 Cognitive enhancement 4.0: fusing humans and machines
 - 2.9 The Internet of Things
 - 2.10 The cloud as a source of new capabilities
3. Economic trends
 - 3.1 The increasing capital imbalance in the world
 - 3.2 Increasing unemployment of the youth, including HEI graduates
 - 3.3 New HE providers offering sharp prices or free options

- 3.4 New business models for HE provision
- 3.5 New specializations and new alliances of HE players
- 3.6 Increasing future need for high-level ICT skills for knowledge work
- 3.7 The decline of the “knowledge economy” as utopian future
- 3.8 Privatization and increased private share of costs
- 3.9 Rising costs of higher education
- 3.10 Decreasing education delivery costs
- 3.11 Decrease of production costs for data, data processing, analysis and synthesis
- 4. Environmental trends
 - 4.1 Global and local challenges that require intelligent answers
 - 4.2 Broadband as a physical health threat
 - 4.3 ICT as a potential health threat
 - 4.4 Threat of physical disturbance of the Internet
- 5. Political trends
 - 5.1 Privatization of higher education, HE for the wealthy
 - 5.2 Declining value of grades and increasing student loan debts
 - 5.3 Efforts to increase higher education enrollment in emerging economies
 - 5.4 Gradual acceptance of ICT literacy as one of the basic enabling literacies
 - 5.5 Weakening of institutional boundaries
 - 5.6 Threat to human rights due to the Internet of People and Things
 - 5.7 ICT dependency as security risk

The participants of the high-level expert workshop held in March 2015 (more details are available in the next section) were asked to examine the discussion paper and the trend analysis results and to assess the trends based on their potential impact on education (policy) on a scale of one (very low impact) to four (very high impact) and their certainty of the fact that the trend really existed on a scale of one (highly unlikely) to four (highly likely). The following trends were considered to have high impact (scored above three) and high certainty (scored above three) by the participants:

- the worldwide rising demand for higher education;
- the increase of long-distance interconnectivity and collaboration;
- the increase of fast and unpredictable changes in technologies;
- big data and the cloud;
- an exponential increase in all ICT-enabled opportunities;
- increased worldwide Internet access but remaining digital divide;
- an increased role of open distance learning in growing economies and remote areas;
- global and local challenges that require more intelligent answers;
- more efforts needed to increase higher education enrollment in emerging economies.

Some trends were considered as having lower impact but high certainty:

- world population growth;
- ageing population in developed countries; increasing share of younger population in developing countries;
- increasing number of MOOC and increasing number of registered students;

- visualization;
- augmented reality;
- simulation, gamification, and the Internet of Things (which still was considered to have high impact);
- the increasing capital imbalance in the world;
- rising youth unemployment, including graduates of HEI;
- new business models for HE provision;
- increasing future need for high-level ICT skills;
- a decrease in production costs for data, data processing, analysis and synthesis.

Controversial assessments on the impact of the following trends and issues were given by the experts:

- machines becoming colleagues;
- the increasing capital misbalance in the world;
- rising higher education costs;
- broadband as a physical health threat;
- the privatization of higher education and rising prices; and
- HE for the wealthy.

The outcomes of this assessment were used as an input for the discussion and formed a basis for the initial list of priority voting issues (new trends were identified during the project workshops). The round table discussion and brainstorming led to the identification of over 30 topics, which were further discussed. These topics were clustered into 18 main topics (see the voting results in the right column of the Table below).

Issue	Cluster	Votes
FUTURE OF LEARNING CREDENTIALS and VALIDATION		
Future of credentials for learning / Will there be a need for credentials in learning 3.0? / Validation / Recognition of learning / The trend and/or pressure to unbundle contents and degrees	Degrees	92
FUTURE ROLE OF FACULTY and TEACHERS		
What will be the role of faculty and staff in 2030? / What skills will they need (pedagogic – subject matter – ICT)? / Teacher triangle / Who will be the new teachers?	Faculty Teachers	49
BUSINESS MODELS		
Imagining business models for 2030 / Which business model could promote OER?	Business models	57
FUTURE CURRICULA and LEARNING CONTEXT		
How can education and the job market be better aligned? / How will develop the labour market with regard to ICT skills? / How important are regional aspects? / Why is the digital divide perpetuating?	Curriculum input / process	47
The future of learning conditions for “learning to learn” and “learning to think”	Curriculum conditions	26
Mobility and society – the connectedness (embracing the use of ICT) / What opportunities does the interconnected world provide? / Will lifelong learning be within or outside HE?	Curriculum context	25

Issue	Cluster	Votes
How will machine learning change what we need to learn?	Curriculum contents	24
How will the Internet of Things influence HE? / Will persuasive technologies and the availability of big data influence higher education in 2030 (environment, curriculum, etc.)?	Curriculum conditions and contents	20
How can technology help to synchronize education and industry? / The role of ICT in improving the integration of new research outcomes into curriculum and educational materials / How can ICT facilitate lifelong learning?	Curriculum tools	20
Different ways of learning 3.0	Curriculum contents	17
CHANGING ROLE of HE INSTITUTIONS		
Higher education is a part of a much larger ecosystem	Role of HE	43
Control of data (learning analytics and ethics)	Role of HE	38
Renewal of the social contract of higher education with the society / What is the social value of HE in the future society that is characterized by open access to sources of knowledge? / What does this imply for its role?	Role of HE	32
How can the rising demand be met? / Different regions with different challenges / Role of ICT	Role of HE	24
What are the model scenarios for the different regions?	Role of HE	22
What will be the role of HE in the power structure of the future? / Will there be diversification (e.g. elite vs mass educational institutions)?	Role of HE	21
How can the bias of the status quo be overcome?	Role of HE	13
ICT success / failure in relation to investment?	Role of HE	4

Further discussions at this and other workshops revealed the main topics that became the framework for formulation of the survey questions.

Consultations

During the series of expert workshops arranged within several large-scale conferences on ICT in education, the future of higher education and ICT was discussed with active involvement of experts and key stakeholders.

The first workshop took place in October 2014 in Moscow during the International UNESCO IITE-2014 Conference “ICT in Education: Trends, Opportunities and Challenges of ICT-Integrated Pedagogy”. The workshop was aimed to brainstorm the project concept and research methodology and plan the project activities.

The second workshop was organized by UNESCO IITE and the Section of Higher Education (UNESCO Education Sector) on March 25-26, 2015 at UNESCO Headquarters in Paris. The event was attended by leading experts in the field of ICT, higher education and foresight, as well as representatives of international organizations, associations and consortia: EDUCAUSE, International Council for Open and Distance Education (ICDE), the International Federation for Information Processing (IFIP), New Media Consortium (NMC), Skoltech, etc. Representatives of leading universities from Australia, Brazil, China, Korea, South Africa and UAE, as well as IT-companies, took part in the meeting.

The main objectives of the event were to review the results of the initial phase of the project, discuss the desk study and trends scan outcomes and develop a coordinated research methodology and plans for the next stages of the project. During the workshop the participants took part in the foresight exercise, which included brainstorming (with voting procedure) to uncover the most urgent future issues. The brainstorming and voting led to the selection of priorities for future issues related to ICT and HE that were considered to deserve further discussion in the higher education community. This selection was used as a framework for the survey and an input for the next workshops.

The third workshop was held within the Fifth UNESCO IITE Conference for UNESCO/UNITWIN Chairs in ICT and Innovative Pedagogy “UNESCO Chairs Partnership on ICT Use in Education” organized in June 2015 in St. Petersburg. This workshop was attended by experts and stakeholders in higher education and ICT and was mainly aimed to test the design of the survey. During this workshop, discussions were held on the basis of the answers given by the participants to a set of draft questions for the survey. Questions were answered in a standing Delphi format to improve the insight into controversial arguments and rationales in the hope that the participants might arrive at a consensus.

The fourth workshop took place within the preconference events programme of the 26th ICDE World Conference “Growing Capacities for Sustainable E-Learning Provision” organized by ICDE and Unisa in October 2015. The participants were high-level experts, administrators and practitioners in the field of higher education and ICT, mainly from Africa, Australia and South America. Discussions were based on the answers to selected survey questions using a standing Delphi format. On the basis of the chosen topics, the workshop participants designed their own questions related to the social contract between universities and society, the maintenance of a social divide between campus-based learning and open and distance learning, digital divide, and the necessity of scaling up HE institutions.

Online survey

The survey was based on a questionnaire containing open- and closed-ended questions focused on the following topics:

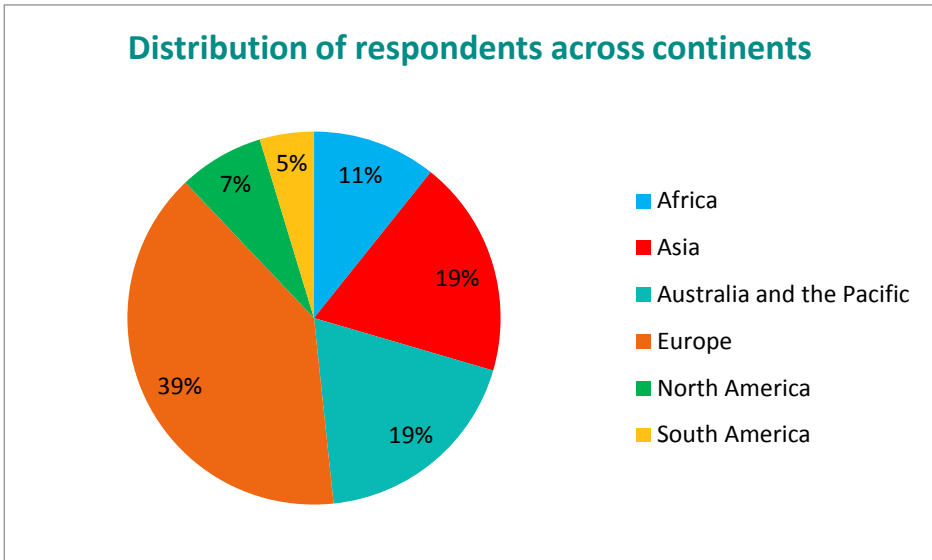
- Future curricula and learning contexts
- Future learning credentials and validation
- The future role of teachers and faculty
- The changing role of HE institutions

The questions were formulated within the framework of the issues selected and refined during the expert workshops. The questionnaire was open at the UNESCO IITE website from June to October 2015. All workshop participants were invited to complete the questionnaire. In addition, a letter with invitation to join the survey was distributed to the main international associations of universities and higher education institutions.

The questionnaire (Annex 1) included three sections: the first and last sections were answered by all respondents, while the second section was addressed to respondents involved in the decision making at institutional or (inter)national levels. The answers of the respondents provided a comprehensive overview of the major challenges that higher education faced and will continue to face as a consequence of the sudden technology-induced changes in the society, economy and education. They also

provided a rich source of visions for further thinking and debating on the future of higher education at national and institutional levels.

The survey was answered by 147 respondents from 54 countries, covering all continents. Most of them are based in Europe (39%), Asia and the Pacific (19%). The other responses distributed as follows: Africa (11%), North America (7%) and Latin America (5%). The distribution by country is presented in Annex 2.



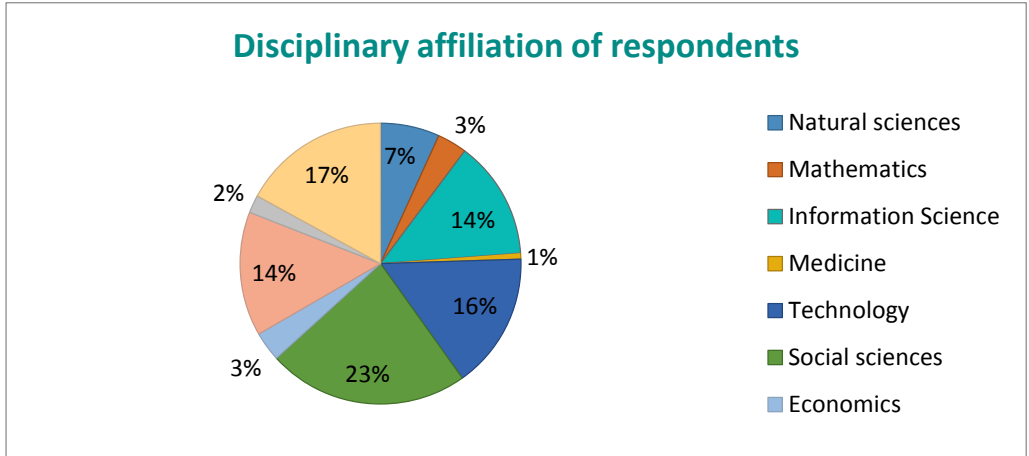
The number of respondents and their uneven distribution by country did not allow for conclusions on country-specific differences; however, some differences were revealed in the answers to close-ended questions. Despite this, the results of the survey can be considered as a benchmark for national situations through national surveys that would address similar issues and could foster national and institutional debate (foresight) on these issues.

The majority of respondents (80%) are employed by higher education institutions (HEI). The remaining 20% are affiliated to education authorities, quality assessment/assurance agencies, international organizations, for-profit social enterprises, private companies, ODL institutions and distance education associations, consortia/associations of universities/HEI, education consultancy agencies, technology companies, research institutions or research and education companies for professional training and consulting. A few respondents involved in in-service training of teachers and secondary school teachers contributed to the survey. Almost a half of the respondents (45%) hold leading positions or top advisory functions as (Vice) President, (Vice) Dean, Board member, Director or Manager. The other half (48%) of respondents are lectures, professors, teachers and researchers who are employed by higher education institutions and are familiar with the role of ICT.

Almost a quarter (24%) of the respondents represented very large educational institutions with over 50000 registered students. One of the respondents represented the institutions that have between 20000 and 50000 registered students. Some 23% of respondents are employed by the institutions with 5000 to 20000 registered students, while one fifth represented smaller institutions (less than 5000 students).

The institutions directly involved in higher education that are represented by the respondents are also running research: the majority (57%) spends from 20 to 50% of their staff time for research, whereas 15% of the respondents are employed by the institutions that spend over 50% of their time for research. Some 24% spend less than 20% of staff time for research and only 4% of the institutions are not involved in research.

Nearly half of the institutes represented by the respondents (49%) cover all disciplines, over a quarter (28%) are multidisciplinary institutions, while less than a quarter (23%) represented institutions dealing with a limited set of disciplines. According to their disciplinary background the respondents were distributed as follows:



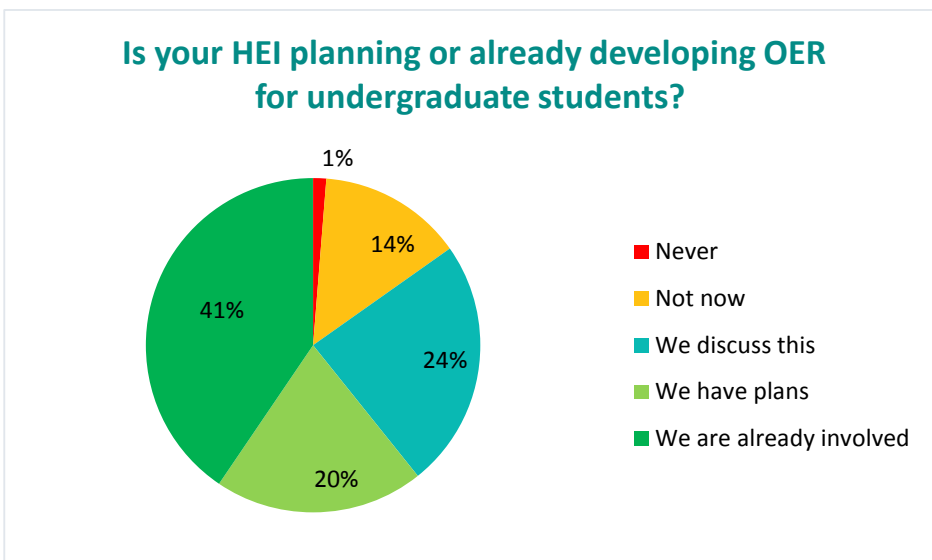
Reflecting the Future Changes in ICT in Higher Education

The future of open content and validation of OER-based learning results

Most respondents agreed that ICT is a tool, enabler for improving the quality and expanding access to education and a driver for changes. The experts stated that all over the world *people rely on education through open courses and universities must respond to these needs and trends*. At the same time ICT induce changes in the character of professional activity and impose new requirements to the skills that are to be acquired to adapt to the rapidly changing labour market environment. However, there were few opponents among the respondents who were skeptical about online learning: *No matter how ICT induces changes in higher education, it can never replace campus-based university education. People use ICT only when they cannot enjoy face-to-face tutorial*.

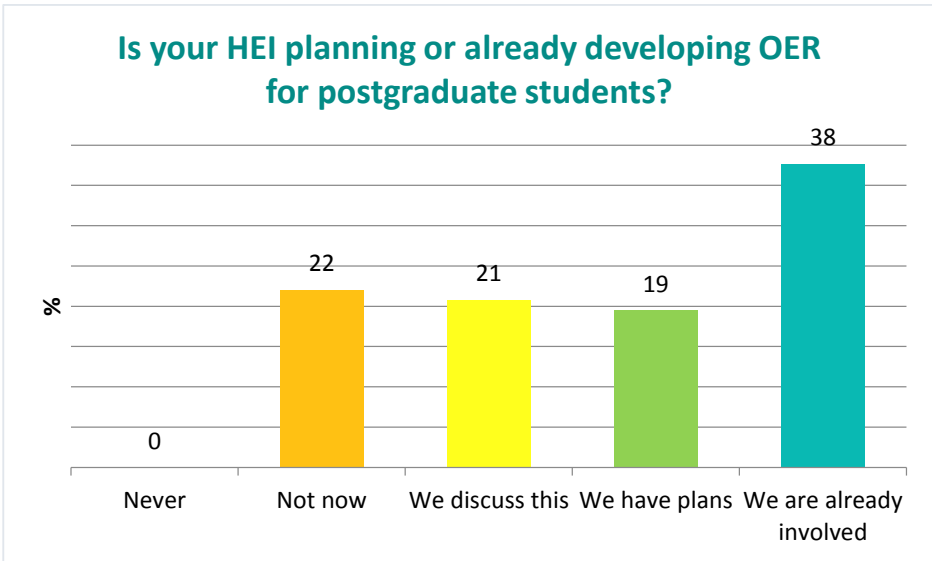
Potential and use of Open Educational Resources

Replying to the question on the level of their involvement in production and use of OER for undergraduates 41% of respondents confirmed that their institutions were already contributing to these activities, while 20% were planning to do so. Still 24% of institutions represented by the respondents were discussing the opportunities to start the process. Some 14% of respondents indicated that they have not started any activity yet, and only 1% stated that they did not intend to do so.



As to the production and use of OER for postgraduates, 38% of respondents indicated that their institutions were already involved in these activities, while 19% were still planning to do so and 21% confirmed that they were discussing this opportunity. About a quarter (22%) of respondents indicated that they were not doing any activity for the moment.

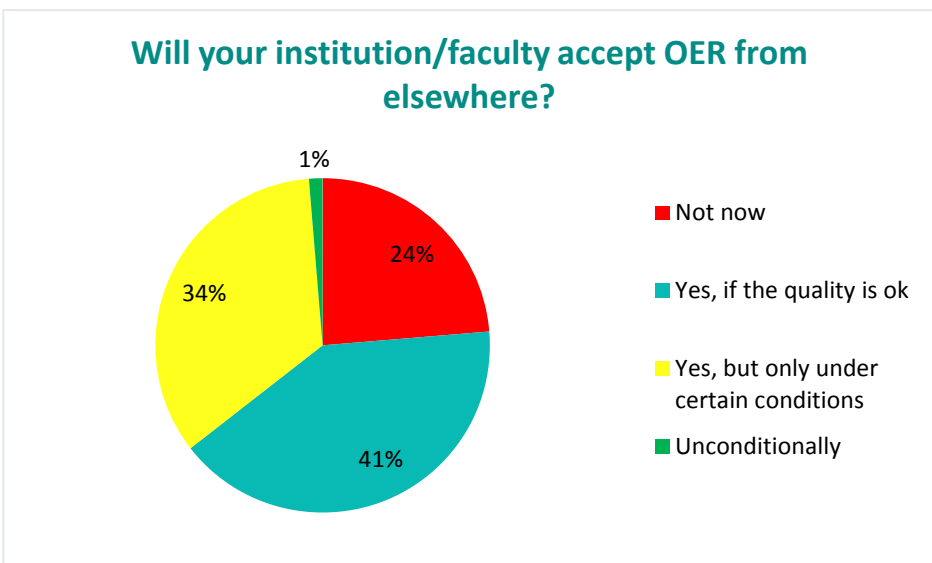
Some respondents mentioned that to satisfy the needs of their students HEI would need to intensify collaboration and accept courseware and resources produced by other institutions, given the quality standards and requirements are met.



Comparison of involvement and preparedness of HEI to produce/use OER to teach undergraduate and postgraduate students shows that the universities are equally prepared to use OER for teaching of both undergraduate and postgraduate students.

Some respondents speculated about new players in this field: they believed that students should also be involved in production of OER collaborating with their teachers and with each other. Teachers and students should create knowledge together.

Only about a quarter (24%) of respondents stated that their institutions were not ready to accept OER produced by other HEI. The other three quarters stated that their HEI would accept OER produced elsewhere if the quality is high enough (41%) and if certain conditions are met (34%). Only 1% of respondents stated that they would accept OER produced by other HEI unconditionally.



Almost all respondents expected that Open Educational Resources and Massive Open Online Courses would be integrated into the curriculum within 15 years from now. But only 30% agreed with this statement fully or to a great extent, the majority (57%) agreed to some extent, 13% agreed to a small extent or disagreed.

Those respondents, who answered that open content would be integrated fully or to a great extent, already had successful experience of partial and even integral inclusion of OER in their curricula. They stressed the advantages and drivers that would lead to the acceptance of the use of OER but also mentioned the aspects related to intellectual property rights. Several respondents compared OER and MOOC with respect to their openness and efficiency and shared their opinions about higher probability of the use of OER than MOOC for the above mentioned reasons.

This is kind of technology integration and online content is diffused into traditional classroom already.

We are already seeing the beginning of this process.

I think this is already happening / We are already developing those / We are already doing this successfully / It is already happening for the use of OER but not yet for MOOC.

This is already happening, and will only grow in its extent as more resources become available online.

Many already do that at course level, there is little visibility of this activity, little/no recognition of course leaders using/creating OER. MOOC will probably be limited to those that can make an impact on institutional recruitment as the investment required is substantial.

I see creative instructors using whatever resources they can access to assemble packages for their students' use. In some specialized areas this still involves single textbooks (perhaps with some supplements). In many areas, however, it is possible to find many high quality resources online and in isolated print forms (e.g., reports). MOOC can become a part of this mix.

It has already become a quite common trend in securing contents at the top-tier HEIs in our country.

Academic staff have always relied upon external educational resources whether that be published textbooks or audio visual resources and/or used other people materials whether legally or not. Investment in OERs and MOOC means that there is an even greater range of resources to draw upon. However, all this is also in tension with the need to localise and personalise the teaching to the degree(s) it supports and the students it is serving. For example, while the first year of a physics degree might be similar in many HEIs, the last year is probably not and such diversity, rather than uniformity, is a critical feature of tertiary education which involves, ultimately the co-production of knowledge by fostering inquiring minds rather than training for work. So levels of incorporation will vary significantly.

It is the most sensible thing to do for institutions in developing countries so as to offer better quality programmes without high development costs. In most cases institutions spend a lot of money, they usually have, trying to develop a course from scratch, when there are others who have already gone through the process. So instead of reinventing the wheel, why not just get an OER and adapt the content to make it suitable for the local target group.

Local faculty are highly educated and inclined to do what they believe best in devising support and resources for learning. Where open resources and genuinely open MOOC might be most useful is for smaller institutions with limited local expertise. OER is likely

to thrive much more than MOOC, which are not really courses but communities of people participating at various levels of engagement. OER should receive much more emphasis than MOOC.

In the next few years I think the OER will be incorporated, but the MOOC - only to a certain extent.

Many respondents who expected acceptance of content produced externally believed that this would happen in the near future, as they considered the use of OER to be advantageous in many respects.

Often not now but in the future I expect that they (whether they like it or not) need to become more flexible in this respect (whether it will be MOOC or some kind of other format).

Contents in foreign/regional languages will be in high demand.

It will take time but OER appears to be ... the only solution to the multiple crisis and the financial aspect is crucial so why not.

OER and MOOC will continue to develop and education institutions may find new markets related to this.

OER and MOOC are inevitable sources for universities as they cannot excel in all directions. The goal is to find out how university staff can best incorporate the skills and attitudes for MOOC selection, adoption and integration in their own courses.

Our university will be "full on" - in its preparation to use OER and MOOC. We have one degree design on the table now and will have more to come. OER is being coordinated by the University Library as an internal and external resource.

If the institutions don't, students will. Here is an opportunity not to lose students in the "big picture" but gain new students and improve the choice for existing students at the "little picture" level.

Other respondents mentioned high quality of content, reputation of HEI and availability of appropriate agreements among institutions, which implies collaboration, as prerequisites for the acceptance of content produced by other HEI.

Perhaps finally to a great extent this will depend on the preference of students, if some institutes accept this it will be a good instrument to attract students (with none of your learning activities wasted).

What matters is the reliability and reputation of the institutions offering MOOC.

It depends on a number of agreements about accreditation, credit recognition, content quality, evaluation quality, assessment process, and other issues. If the agreement is achieved, the OER and MOOC will be integrated successfully.

Collaboration and knowledge exchange is an essence of higher education, so "open" - and "massive" - is usual for university, but conservatism of HEI will prevent mistakes in using educational innovations.

Cooperation between different institutions will be more and more necessary in order to meet students' needs.

Some institutions with different emphasis and specialties will cooperate and offer different courses that could be exchanged too.

The sharing and application of knowledge (wherever produced) to creating new goods and services is proving to be more important in knowledge-based societies and economies.

“Not made here” – syndrome is pervasive, but I have personally been approached by several programs who are now using my open online material ... This experience has convinced me that reusing the works of others will become more commonplace in a couple of years, once online material is seen as “respectable” and quality assurance is more straightforward (either through active, careful selection of partners at platforms like Coursera).

Higher education institutions would accept Massive Open Online Courses produced by other institutions, provided the course content is of high quality and meets the learner & society needs.

This’ll depend upon the quality and sustainability of the resource and the value that it can add to an institution.

Some respondents explained their hesitation to accept content from outside their HEI by the fact that institutions prefer to develop their “own” courseware or lack of interest.

HEI prefer to develop their own courseware.

A university having sound foundations and most of professors approach topics in different ways, so it is unlikely that ready made courses might be accepted as they are.

It would be very logical to do so, and economically wise, but the faculty is reluctant to reuse materials produced by others and often prefer to produce its own materials. Strategies should be developed to overcome this obstacle.

While there are academic and financial reasons to share the good learning experiences, there are two reasons for the continued independence of educational institutions. Firstly, institutions need to demonstrate their own value to maintain funding and may be reluctant to give away significant value. More importantly, learning will continue to be facilitated by personal interactions (albeit digital ones) and students will continue to value teachers who can offer personal attention.

They’d rather produce their own.

I see no evidence of interest in that in the institution where I am based.

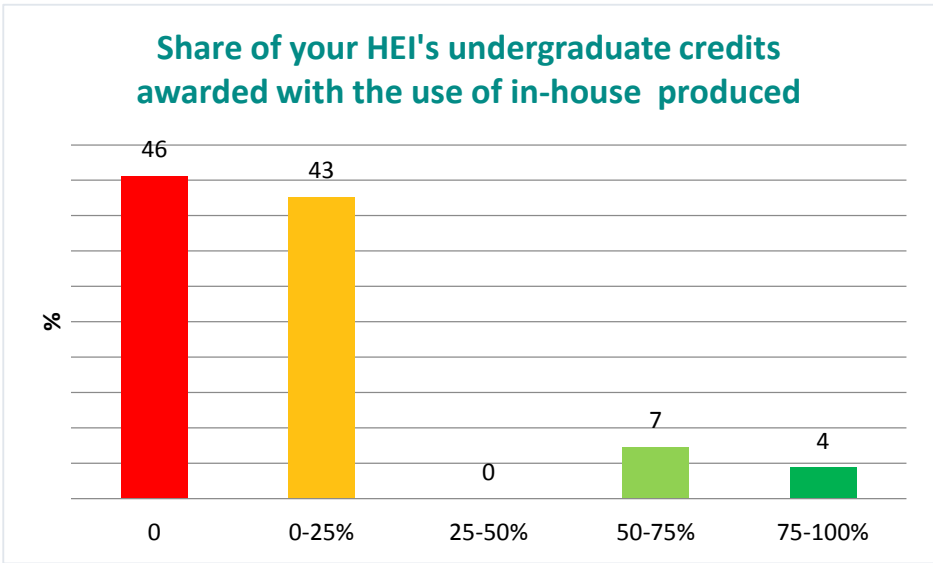
The leading universities have to develop and deliver their own unique content as before.

One respondent even mentioned that *campus-based higher educational institutions will not incorporate OER or MOOC, because they do not need them, and it is not necessary at all for campus-based students to use OER or MOOC. The reason is mentioned above: when you can enjoy face-to-face tutorial of a professor, why should you use cold and indifferent machines?*

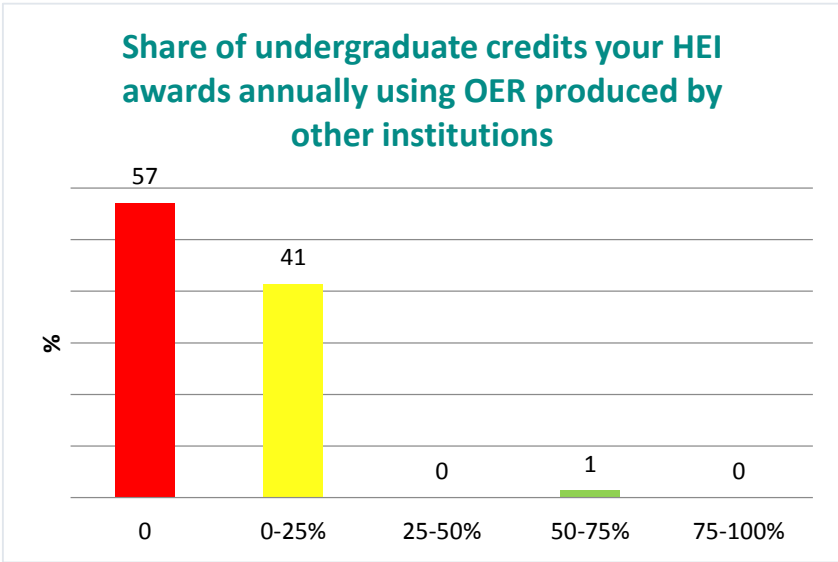
Recognition of OER/MOOC-based learning results

According to the estimates of the respondents, 46% of HEI they represented did not award credits for learning with the use of OER produced within the institution. The share of those who indicated that the share of such credits is very low (0-25%) was 43%. A positive sign is that 7% and 4% indicated that the share of credits awarded as a result of using in-house produced OER was 50-75% and 75-100%, respectively. There is a clear dichotomy between institutions with a majority of OER-based credits (13%) and a large group of those, which either did not use OER-

based credits or awarded 0-25% of credits for studies with the use of in-house produced OER (87%).



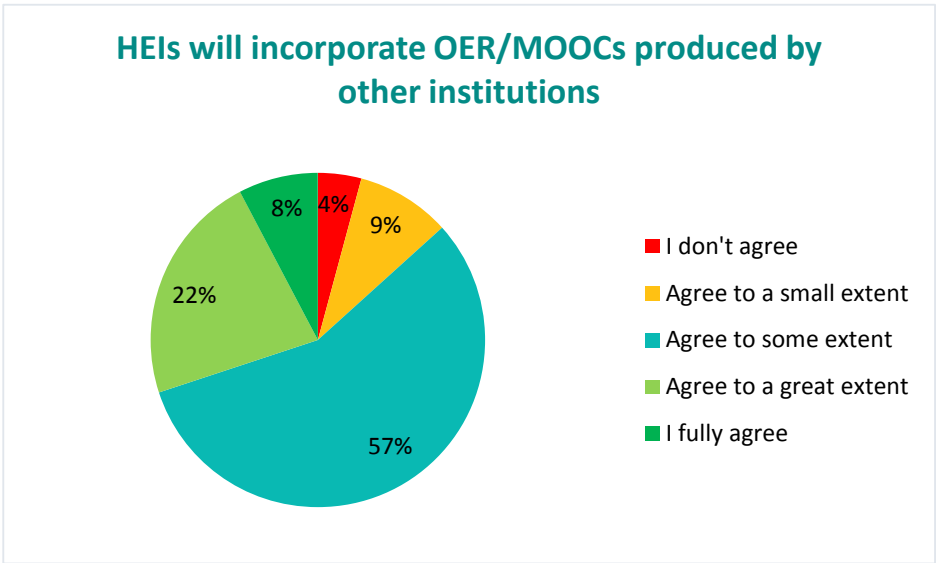
The majority (57%) of respondents indicated that they did not use credits from externally produced OER, while 42% confirmed that they awarded some credits (up to 25%) for OER produced by other institutions. Only 1% of respondents indicated that 50 to 75% of credits were awarded for OER produced elsewhere.



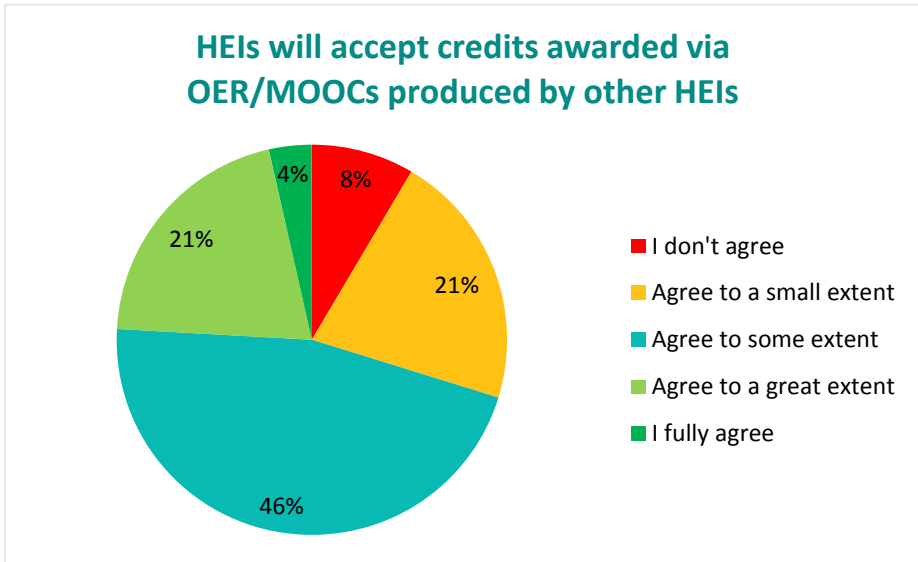
Cross check of the answers to the above four questions shows that even though 38% and 41% of institutions used OER produced externally or in-house, the share of credits awarded for the learning with the use of these resources varied within 0%-1% and 4-7% (for 75-100% and 50-75% shares), respectively.

Almost all respondents expected that Open Educational Resources and Massive Open Online Courses would be integrated into the curriculum within 15 years from now.

But only 30% agreed with this statement to a great extent or fully, the majority (57%) agreed to some extent, 13% agreed to a small extent, 4% agreed to a great extent or fully, 8% agreed to some extent, 13% agreed to a small extent or disagreed.

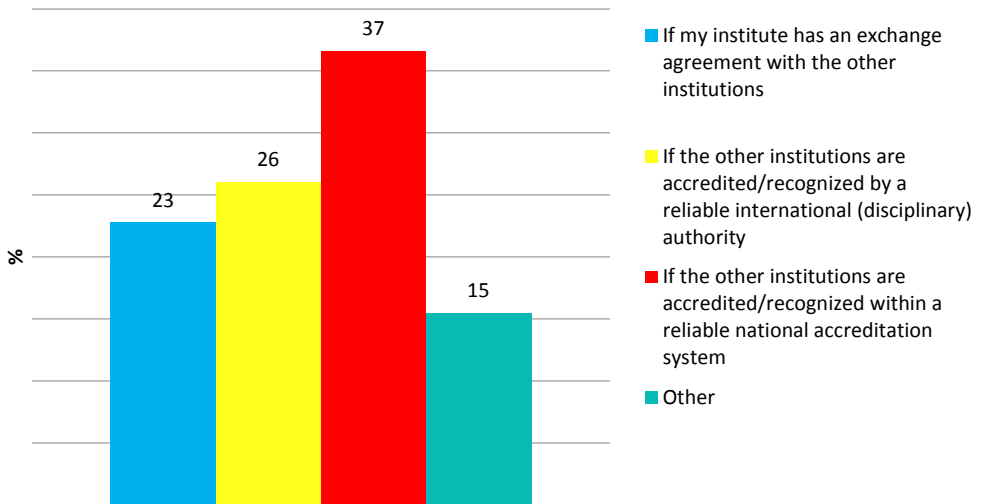


The respondents were less optimistic about the probability of accepting credits awarded for learning results obtained using the open content (OER and MOOC) produced by other HEI. Still most respondents expected that the credits for OER and MOOC would be increasingly accepted within 15 years from now: only 25% agreed to a great extent or fully (4%), while 46% expected this to be the case only to some extent, whereas 21% agreed to a small extent and 9% disagreed.



The responses about the prerequisites for the recognition of credits for OER and MOOC produced by other HEI distributed as follows: 37% of respondents believed that this would happen if the other HEI would be accredited within a national accreditation system, 26% relied on international accreditation, 23% mentioned the necessity of an exchange/recognition agreement between the institutions, and 16% of respondents proposed other conditions (some of their answers are presented below).

Under what conditions would your HEI would recognize credits for OER/MOOCs produced by other institutions?



Through the system of badges and credits recognition HEI will increasingly use this opportunity within the agreements established among them.

Especially in Europe, as long as ECTS are awarded for MOOCs, which seems to be the emerging model, institutions will need to accept them.

A formal cooperation might be the most sound condition of acceptance of credits – no doubt. Depending on the profile of the studies, universities might accept MOOC certificates because they would be assured by an “installed process” about acceptable quality needed to base their special field of education. Universities might even require minors that they themselves are not ready to provide, but could allow a broader diversity of professionals to arise. Universities should not have any problems in accepting MOOC certificates on elective subjects that are related to their developed field.

Depending on the quality assurance results regarding the specific course/s.

Opportunity to formally re-examine credentials, for example, student completes an invigilated exam. At least until online proctoring services are more reliable.

“Yes” to national and exchange agreements and “to some extent” to international authority. However, accreditation for “trusted” MOOC, even those produced by the institution itself, would have to address the problem of assessment/proctoring.

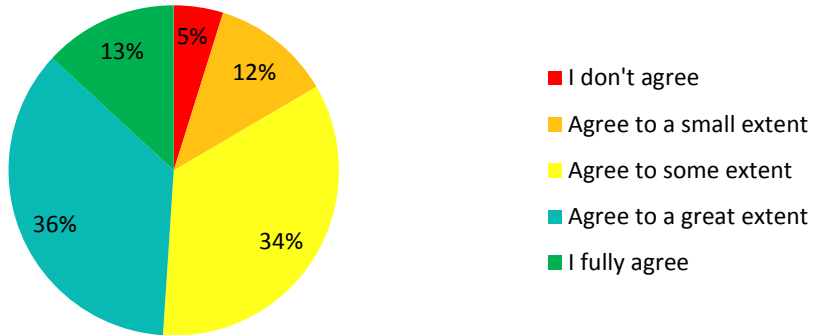
The transfer of credits to institutions will probably always be limited, no matter their source. There are limited incentives for an institution to do so. The institution may be willing to accept credits if it brings new students, or if it doesn’t have a course that is offered elsewhere. In general, however, there are substantial disincentives to accept credits from outside.

If all the three options are in place: qualifications framework, reliable international authority and agreement between institutions. This actually speaks to the concept of collaboration and partnerships between institutions. And I believe this is the future of education.

If the MOOC course outcomes and content match or are comparable with the outcomes of a course offered by the institution, they would be accepted as transfer credit and would meet degree requirements as is the practice for accepting courses from other schools.

A vast majority of respondents agreed that the ICT-induced changes, including those related to the use of OER in higher education, would make HEI to rethink the systems of awarding credits and validation of learning results. Almost a half of respondents (49%) indicated that they agreed with this statement fully or to a great extent and 34% agreed to some extent. Only 12% of respondents agreed to a small extent and 5% believed that the credit awarding and validation systems would remain unchanged.

ICT-induced changes force HEI to rethink the system of awarding credits and validation of learning results



Recognizing the traditional role of HEI as the bodies that award higher education degree and are reluctant to modify the credit awarding system, the respondents stressed that there was an urgent need to rethink how the degrees were awarded to ensure more flexibility if the degrees should remain valid and be accepted by employers and the wider community.

We need a much more flexible system in order to answer major societal challenges related to the enrollment in HE and the output of HE.

HEI/universities have two distinct roles: providing training to their students and certifying the level of competence acquired by them. The second role will likely remain a core function of these institutions, even more so when there are informal training opportunities, to verify that students have properly benefitted from their training by passing a close scrutiny by qualified personnel. A change that will likely happen to these certifications, especially in the technological and scientific fields, could be to require follow-up exams to certify an updated competence in a certain field, considering the current rapid obsolescence of many technical skills. This method is already used by many private companies that provide technical certification: their certificates expire after a limited span of time, if not continuously renewed with other exams. The possibility to access top notch material developed and tested in the most prestigious institutions could allow all other institutions to better allocate their resources to the still important practical training like laboratory and practical work, etc. and to the previously mentioned role of certifying the acquired competences.

Informal and formal learning must be combined, since there is a huge demand and a large offer, which learners, teachers and institutions can benefit from.

ICT removes barrier to the internalization of education and also barriers to private initiatives. The credibility and validation of learning results, though, remain the prerogative of higher

educational institutions such as universities, but is somehow challenged by new forms of recognition offered in MOOC and other initiatives.

With new options for validation arising in professional bodies, other higher education institutions, and a widening range of informal but highly regarded learning institutions (museums, institutes, NGOs, etc.) it is imperative that institutions reconsider delivery processes for global access, unbundling of offerings, and validating learning from a much wider array of opportunities.

Awarding credits and validation of learning results are influenced by what the market (students, employers, etc.) requires. Some require a certificate to demonstrate learning, some require a portfolio of work completed, some require actual demonstration of competencies.

Grading model for “face-to-face + e-learning” has to be basic for changing awarding system. Crucial questions are arising about the need for formal degrees and qualifications when knowledge and learning are abundantly available. Other related questions include the way in which institutions will accept formal and informal learning credentials (such as degree attainment or course completion) from elsewhere and the increasing need for lifelong learning, rather than a single point-in-time, immersive educational experience. These issues raise the possibility of fragmentation (or unbundling) of learning activities and credentials, particularly when lifelong learning dimension is concerned.

It depends on how the individual student’s learning results are assessed. If the assessment methods are rigorous, defensible and valid, then there should not be an issue.

ICT only facilitate the teacher-learning process, especially in an ODL environment. Such a facilitation results in better learner’s results, as well a higher rate of achieving the objectives set out from the beginning. The ICT are not supposed to change the system of awarding credits or validation, which are platform-independent.

Some respondents stressed that universities should play an important role in the revision of the certification policy.

Universities will have to consider which kinds of certificates to accept as students’ previous studies or just acknowledge these courses and make students take examinations after which credits are given... Universities will need to consider what exactly are they able to offer as a unique value for students to make them enroll! The role of universities still should remain as the tower of knowledge, providing the conceptual background for higher levels of knowledge and pursue research together with participants from industry. This should differentiate university learning from fragmented self-development or guided development which is important as lifelong learning.

Since some online courses are offered, the administration of the college initiated changes in credits and validation.

Some institutions take time to rethink their teaching and learning approaches and policies that guide them. But some do not realize that there is a need for reconfiguring the whole system.

With new options for validation emerging in professional bodies, and other higher and informal education institutions, reconsidering the delivery processes for global access, unbundling of offerings and validating learning from a much wider array of opportunities is an imperative. Though in some countries the changes are slow.

Criteria for promotions, the way the courses are delivered, assessment processes are all changing in a way in recent years.

In the future we may see that more institutions are willing to acknowledge and award credits for knowledge obtained through open courses offered by themselves and other institutions. Universities may have a testing service for that purpose as their side business.

Increased access to learning and portability of the evidence of achievement will change conventional systems of awarding credits and validation of learning results. However the rate of change will depend on many other factors such as funding models for higher education, the establishment of trust networks amongst institutions and alignment between higher education and industry. Different disciplines are likely to move at very different rates reflecting the importance of external drivers. This will probably result in a composite picture for some time.

There remains a strong demand for accredited (industry recognized) first degree. There is more flexibility in postgraduate degrees. Recognition of prior learning and crediting of MOOC for example will be implemented very quickly with numerous higher education institutions currently implementing or at least investigating this pathway.

Degrees and credits will not be the only currency by which student's education/employability/skills are measured. OER, MOOC and Wikis can contribute largely to both informal and formal learning.

Online education provides students with new opportunities both within and outside their own university, and more students join online programs rather than study on campus. Methods of delivering education change accordingly. Content of programs is affected by ICT as society and working life changes. Modes of communication are developing fast both in work and society at large.

We are aware that the changes in the HE environment are creating new forms of certification and are exploring these. While the number of short online courses is increasing, this is not really a new form of earning credits, although quality assurance mechanisms are receiving attention. We are aware of and experimenting with new forms of microcertification such as badging and MOOC specializations. We have also discussed allowing students to take our examinations without having to attend the courses.

In our country, public higher education institutions have to comply with national guidelines regarding degree courses and evaluation processes.

There will be a kind of modularization in education, with people picking up courses at different institutions. This will cause a change about what is needed to fulfill the formal requirements for a degree and raises the question of quality assurance for the different courses making up the final degree.

Our experiences vary: our students follow MOOC and want to use them in degree programmes, we offer courses to professionals who start later in a degree programme and they want to validate their courses and their work experience as part of the degree programme, we offer MOOC and other universities do ask us if students deserve credits for them, etc. This makes us to think about awarding credits and validation of results within and outside education.

The digitization of education as well as the open movement calls for reflecting upon the current system, not only in terms of designing teaching and learning experiences but also in the way that these institutions are structured. Higher education Institutions can no longer be thought of as separate entities but need to be opened up to meet current needs.

Other respondents stated that a new balance between informal and formal learning should be established. Some respondents stated that the credibility and validation of learning results would remain the prerogative of higher education institutions, but the credit awarding and transfer system should be diversified.

Credits will become more important than ever in an unbundled system of education. In fact, in Europe, the new version of the ECTS guide will for the first time enable non-HEIs awarding ECTS – focusing more on learning outcomes than on the type of institution providing them.

Microcredentialing is becoming more important; however, this requires a great extent of authenticity and trust.

It's urgent to rethink how we award degrees and be less linear or traditional in our thinking if we want our degrees to remain current and perceived to be valuable by the wider community.

Institutions that are considering entering the “microcredentialing” space will do so irrespective of wider trends. Similarly most universities will not. The main change in my opinion is likely to be at the margins where a smallish number of institutions (mainly outside universities) will see a “market opportunity” or a chance to better meet their students’ needs and will get into this space.

Technology-enhanced learning will continue to increase. Online and blended courses continue to grow, but with the same credits as campus-based courses. However there may be more credit options, for example, partial course credit for students who pick and choose segments of a course. I think we are seeing a drop in enthusiasm for MOOC because of low completion rates.

In our country, the idea of credit transfer is emerging and some higher education institutions collaborate with other universities for this purpose.

There are some rules and requirements for credits and validation of learning defined by a commission for accreditation for syllabus of university studies which should be respected.

ICT-induced changes – how education is delivered and how learning happens – make it possible to award different kinds of credits (different kinds of learning outcomes can be made visible). The validation of learning results can also be approached differently (e.g. in a more networked manner, peer review/accreditation, etc.).

The respondents discussed the ways to promote flexible personalized learning pathways for students to follow during their university studies and after graduating in the process of lifelong learning. An important issue is the assurance of the quality of content. Another urgent issue is the revision of assessment practices – what should be fulfilled to meet the formal requirements for a degree and how the identity of students is validated in online assessments.

Time would not be a criteria anymore as the main principle of online course lays on being able to learn at one's pace, which is a good news for people with disabilities who until now suffered from time constraints. Flexible learning pathways will also impose new methods of validation. More scrutiny for cases of plagiarism might be needed. Learning results would be evaluated – how one is using his/her acquired knowledge than just replicating what he/she has been taught, how one is interacting with others, etc. Nonformal and informal learning could be more commonly a part of the assessment and self-assessment.

Awarding ECTS for MOOC was explicitly condoned by our Minister for Education, therefore we consider this as a development we will have to accommodate. The question is how to evaluate the content and quality of assessment with so many courses and institutions worldwide and no common accreditation system.

Assessment practices remain largely unchanged, except for the margins where there are some innovative experiments.

Handheld devices have provided access to knowledge to a larger population of developing economies. Youngsters are much more aware and networked. The increased recent interest and demand to tertiary education in our country can be largely attributed to social media. This is social network induced learning. At the tertiary level such networks can be used to get peers to help each other solve subject-based learning problems and inculcate reflection and deeper levels of thinking. Such social connections can induce lifelong learning. Therefore assessment would necessarily have to judge whether participation and learning on the right track is taking place.

More students enter the institution with a certificate asking if and how this can be connected to the study of choice. If we also have an idea about the quality of these open educational resources and courses, we could use them within our curriculum as well.

Some respondents raised the issues of related changes in pedagogical approaches, in particular, those related to modularization of content and assessment of learning results.

The mode of teaching has been changed to online in some programs from face-to-face or distance learning. Testing methods need to be modified.

ICT-induced changes need pedagogical changes and students are choosing study packages from different providers. We have many students who already cannot attend on-campus and are studying online or through MOOC... we are often worried about how we can “assure their individual learning” when we can’t be sure that it is the actual student doing the work submitted...

Identification of the individual completing the assessment on mobile and convergent technologies to reduce fraud is essential for validation. International assessment standards need to be harmonized so that the expectations are consistent.

Assessments, especially formal assessments pose a problem for distance courses/MOOC/ etc. Validating learning results in an online environment is and always will be problematic.

With e-portfolios becoming popular there is a need to shift from completely summative venue-based assessment to more personal, continuous non-venue-based formative assessment, that shifts the focus from grading to a certain degree.

The obvious question is “Did the named student complete the work?” ... there are questions about the context in which the work is done, the resources used, and so on... In my experience, the solution to the above questions is to assume that a student will collaborate with friends, will use whatever resources are accessible, and will generally take the least strenuous path to complete work. Once those assumptions are made, instruction can be organized in a way that maintains a valid, high quality learning experience in those circumstances (e.g., make assignments that require students to talk to their peers about the topics). This can be very different from the approaches taken in face-to-face settings.

Instructors concerned about cheating are rethinking the format of assessments to move toward more project-based work. They are also including a broader array of assessment formats such as digital storytelling. Many of them make courses more modular to accommodate more students, and are making degrees more flexible and open to awarding credit for prior learning.

Some respondents expressed their concerns about time and other limitations and mentioned the reluctance of institutions to change.

Accreditation systems are too complicated to be altered because of technological developments. Also thus far most of the developed materials were not fully satisfying from the academic point of view. I therefore believe that changes should be limited and made very carefully.

There are significant local differences and a general tendency to require specific kinds of information for a degree. Right now it is hard to get transfer units accepted between comparable institutions in the same country. The process will take years on a global basis.

In actual practice there is no force on HEI/universities to rethink the system of awarding credits due to ICT-related development. However, there is an inclination towards rethinking the future. Unless there is a clear policy to adopt, we see there is less chance for voluntary efforts.

Such methods allowed institutions to change the way in which they offer content, but they are much more reluctant to change the credit assignment method.

Although use and access to ICT should bring about changes, traditional mechanisms are slow to change.

Most of HEI in our country (where OCW, MOOC and Wikis are available to students) do not award credits for the courses that the students took from other HEI with no partnership on credit exchanges through MOOC and OCW.

Accreditation and validation of learning requires the evaluation of evidence provided through assignments or recognition of prior learning. While ICT extend and change the nature of assignments and the way evidence might be presented, the final evaluation still needs high levels of academic staff expertise and time investment. More significant change would require sector and society wide change, e.g. that acceptable "qualifications" can be of varying "sizes" and not be driven by the 3/4 year Bachelor degree and 1/2 year Master's degree. The latter in itself does not depend on ICT induced change, however, ICT do mean the portability and visibility of evidence/credits/badges is increased.

Many institutions have not yet fully implemented the use of ICT in many of teaching and learning activities. So not so much has actually been done by academics to redesign their programmes' content and assessment procedures to include ICT in delivery and support of courses.

The change of the system of awarding credits and validation of learning results takes time.

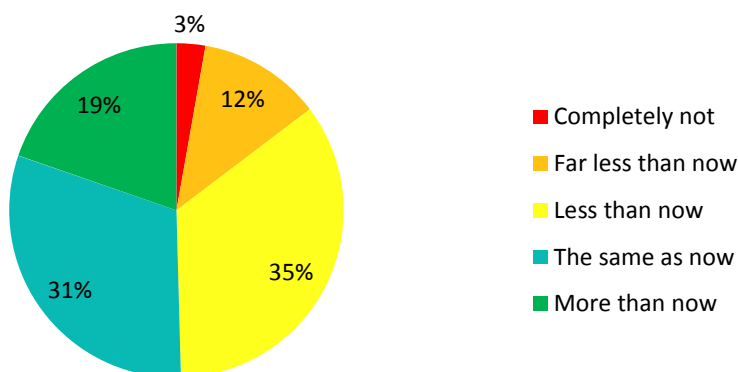
Our institution is moving towards online mode of delivery in a big way and there are talks about removing all face-to-face teaching modes and to have only blended modes with the greater emphasis on online or eLearning. This is counterproductive and irrelevant...

Institutions still fight against a joint system of co-awarding and validation of credits and certificates.

Expectations towards revision of the system of HE degrees

Many respondents expected that the future labor market need for formal higher education degrees might decline in the coming 15 years: 35% indicated that the need might be less than now, 12% expected the need to become far less than now and 3% expected this need to disappear. At the same time, 31% expected no change in the request for the formal higher education degrees, while 20% expected the request to rise. Many respondents replied that the changes in the system of HE degrees should be coordinated with the labour market needs and skills requested at the job market.

Will the labor market require formal HE degrees 15 years from now?



The respondents who expected that the need for formal degrees might increase mentioned that the diversification of learning paths made recruitment process more difficult for employers seeking for reliable formal degrees.

As technological and scientific skills become more specialized and complex, it will become important to have as much guarantees as possible of the level of competence acquired by a candidate.

Demand for formal higher education degrees will increase as we increasingly move to knowledge-based economies. The flexibility in awarding these degrees (i.e. mixed mode, online and competency-based options) will also increase.

Assessing the claims of candidates and considering their abilities and competencies will be an issue if there is no formal certification process. Although fraudulent practices regarding bogus degrees would be increased, the need for certified declaration of a course or program would remain high, especially in developing countries.

Degrees are a proof that you have succeeded in accomplishing the required courses. The future labor market will need them forever.

Employers currently claim that higher education is only partially successful in preparing graduates for work. However, formal qualifications do provide employers with a discriminator to sieve through applications. While large businesses may be able to invest in complex and careful recruitment processes, smaller businesses will continue to rely on such indicators as qualifications. Higher education degrees will continue to have value for some time.

We already have a very mixed qualification economy. In some employment areas, degrees are seen as essential and are statutory requirements. In emerging employment areas, degrees may not be needed initially but over time employers do expect appropriate degrees to help with selecting employees, e.g. many areas of computing and/or professional bodies or associations emerge. Equally, there is a dichotomy between expecting an initial degree to enter the labor market and on-going CPD requirements or needs to re-skill, which may or may not require full degrees.

With growing emphasis on ICT, those who have demonstrated high level of knowledge and skill, as exemplified by some kinds of HE (i.e., post-secondary) degrees are likely to be in more demand, creating a need for more and more individuals to get at least a two-year post-secondary certification if not more.

Another dimension to this issue is that the public (consumers) will continue to want service providers to be properly qualified (certified) to provide the services they do. We are still seeing new requirements that previously “unregulated” service providers are being regulated and that people working in those industries are required to have formal qualifications as part of that regulation.

At our continent, credentials are the only way that differentiates between the skilled and the unskilled. Rarely do employers give applicants chance to prove their through practical skills. If there are any studies that do not require credentials they surely have other forms of evaluation.

The respondents who expected some change pointed to the fact that the situation would differ considerably between different disciplines and professions. Also some respondents emphasized that the change of labor market needs would probably take more time than 15 years.

This paradigm will take a lot longer time to shift and for an extended period we'll see a range of forms of accreditation (both formal and informal) in play.

Some professions will need academic degrees while others will require demonstration of skills that could be acquired within or outside of a degree program.

Especially for such domains as entrepreneurs, creative jobs and ICT, other degrees than formal will be valued as well. I do not think the situation will change for medical or law professions.

Fifteen years is a very short time span to expect such changes. Besides, such changes will involve huge logistic deployments which I don't see being possible in some countries, if one is to judge from the current logistic insufficiency in many universities.

Many respondents expected that the system of formal degrees and certificates would remain important but the whole certification system would be changed. They tried to foresee the potential ways of its evolution.

The need for certification will not be less but may take other forms, with more frequent updating.

There will always be a need for formal higher education degrees, but their form and content will change (for instance, less knowledge and more competencies), and there will also be other kinds of needs for competencies assessment.

These will not decrease in number, but degrees will need to change to keep up with labour markets and needs of potential employers.

While on the one hand, there will be more valid qualifications on the market, coming from informal/nonformal options, on the other hand, the vast variety of potential qualifications, will enhance the attraction of known brands to employers, in terms of simplicity and trust in the qualifications.

I don't see the need for formal qualifications to disappear or even be dented that much in the next 15 years. At the same time, I expect certain disciplines and levels to see changes in what is considered legitimate form of certification. This will occur particularly in the areas of professional continuing development.

Obviously for some professions and occupations, e.g. law and medicine, a formal qualification is likely to be a prerequisite for the foreseeable future. Similarly, for occupations that attract many candidates formal qualifications will act as a useful “first layer” filter. The radical change is most likely in vocational education where critical competencies and skills can and will be demonstrated in “real time” which is much safer, and more relevant and useful than a formal qualification. This will also apply to nonvocational occupations/professions where demonstrating real time competence and skills are necessary or valued.

Although formal qualifications will always have a place in the labor market – this structured requirement is becoming less and less relevant as the labor market focuses more on skills and lifelong learning.

Contemporary labor markets need professional certificates more than a diploma.

Even though the future labor market will still require and value formal higher education degrees, the checks on where degrees come from will become more laborious and it is very possible that employers will start judging and relying more on other kinds of evidence for merit.

Some respondents expected decreasing request for formal degrees, in particular, because on-the-job, informal and lifelong learning would play an important role in postsecondary education within the next 15 years.

Mostly employers provide training opportunities when they provide a job in general. Thus, more informal education for specialization in a specific field for meeting the job requirements will be required in the future.

As long as the learners can meet the requirements of the labor market, they can be employed, not necessarily having a formal degree, especially if the formal higher education degrees cannot meet the requirements of the job market.

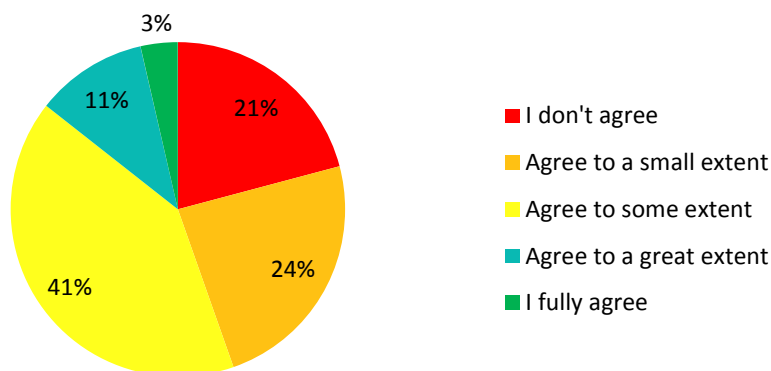
There is likely to be of more interest in records of actual accomplishments than formal qualifications.

Candidates' ability to find and process knowledge would be more important than formal degrees. For reliability, some sort of formal testing would be required to award degrees. The tests would be problem-based in the related field – give problem, give resources, let candidate solve the problem and critically consider the solution.

The variety of opportunities available to develop one's skills and gain competences are so diverse and a myriad of jobs require not only formal education but also specific skill sets.

A majority of respondents expected that OER and MOOC would lead to further “unbundling” or fragmentation of degrees and result in microcredentialling (awarding of “nanodegrees”): 15% of respondents agreed fully or to a great extent, 41% agreed to some extent. Only 24% agreed to a small extent and 21% did not think that the use of OER and MOOC could lead to splitting degrees into micro- or nanodegrees.

Do you think that OER/MOOCs may lead to fragmentation of HE degrees?



Many respondents expected that the changes in the system of credentialing would depend on the changes at the labour market. The respondents who agreed fully or to a great extent considered fragmentation as a positive trend, a change in the academic pathway, an alternative to the existing forms of delivery, even though some of them mentioned that it would take long time before microcredentialing becomes a reality. Many respondents stressed the importance of acceptance of microdegrees by employers and development of appropriate accreditation/validation policy at national and institutional level, as well as quality assurance and accreditation framework.

Unbundling and fragmentation will occur increasingly frequently, but MOOC are only one factor among others contributing to this process.

If (Massive) Open Online Courses are accredited, then it would lead to fragmentation of validation of higher education degrees to some extent.

Fragmentation is the flipside of the coin of diversity and flexibility. However it seems that the benefits are much greater than potential negative side effects. This has to be seen in the perspective that students will face a much higher responsibility and self-organisation in the future. It is inherent to the nature of job complexity and life-long learning.

Courses and degrees will be more and more tailor-made, made of a set of modules adapted for each student.

Unbundling is a new concept, but it has some precursors in the professional learning arena. It will come into undergraduate education as cost savings and curriculum-opening strategy. New course construction will have to consider many delivery platforms at once and will be produced with those multiple platforms in mind.

Greater awareness and unbundling is required. Opportunities to fast track students through degrees or extended degrees based on personalization are very much needed. The inclusion of OER, for example, facilitates this process.

We already do this for the OERu (OER University), it doesn't fragment accreditation, and in fact this makes it clearer.

Time to rethink the aim of education. Is it, for example, to have a Harvard MBA or is it to train the best business leaders for the future based on a global experience and expertise? OER provide a validated personal way for students to construct a pathway to qualification that is equivalent to all other pathways, but suited to the individual and the industry they wish to enter.

We need to move towards a personalized degree structure – let the student decide on the combination of subjects they want to study. For professional qualifications, which are regulated by accreditation bodies, this is tricky, but there is space within these for some units to be decided by the student.

At the end the diploma of the HEI will incorporate the credits from MOOC and OER, so there will be no fragmentation, but inclusion.

It will depend on the institution where students wish to graduate on what their RPL (Recognition of Prior Learning) policy is like. If it accommodates, there will be no fragmentation because the degree will still be awarded as one unit with the student being exempted from taking certain modules.

Many respondents considered the issue of fragmentation of degrees in relation to accreditation of educational institutions.

Accreditation and validation of degrees are subject to national and international regulation and quality assurance/governance mechanisms and these are unlikely to countenance fragmentation of these processes. However, this is different to a certain level of fragmentation of the sources of evidence used to award credit and validate that credit. I certainly expect HEIs to accept credit from their own OER/MOOC, and as with recognition of prior learning and credit transfer, once one HEI has accepted such a credit, it is much more likely that the others will do the same.

Quality and accreditation framework must be in place to ensure the standardization and validation of degrees.

If they are accredited in a country, there is no problem.

As long as the system of accreditation is full proof there won't be problems arising from this form of validation.

I expect that OER and MOOC will have an impact on accreditation and validation. I hope there will be an effort to find an optimal model how to combine existing forms of higher education and OER and MOOC.

Some respondents did not believe that the content and degrees can be split; however, they saw some potential if the decision to share resources is taken at national level.

This means redesign of programs, courses and plans of semesters. This is a very difficult task and it is almost impossible to do this just for MOOC concept.

Funding models are fundamental to the future of higher education degrees. Institutions are likely to minimize cost and maximize access and the sector will therefore increase online learning. However, both government funding and private funding rely on the utility of the degree and the reputation of the institution. If the institution cannot establish what value it adds to the award of a degree, its funding will be jeopardized. Shared resources (OER or MOOC) are most likely to be shared where funding arrangements can be managed, for example, within a national system.

First, it is not really possible to recognize credits from OER, as these are just resources. There is little evidence that universities are shifting their accreditation and validation processes because of MOOC and little reason to suspect they will change much in the future.

Unless institutions and accrediting agencies change dramatically, this is not likely.

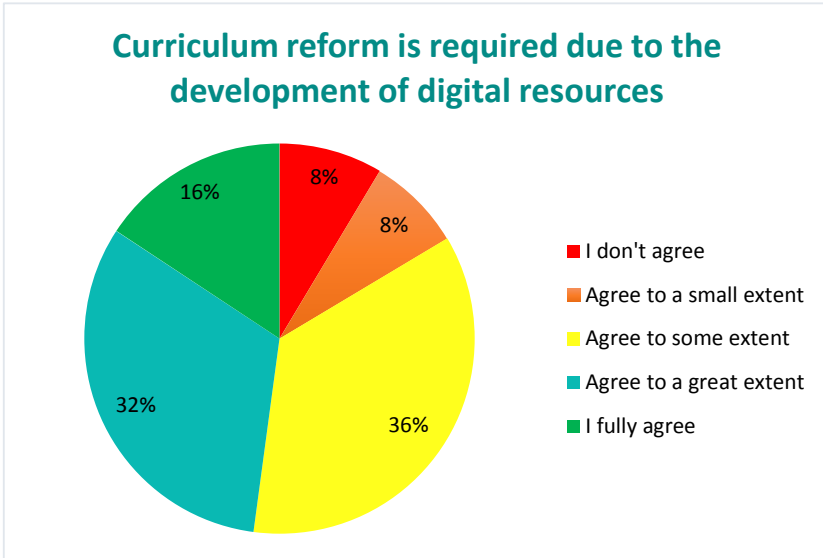
The institution has to attest to the fact that a student has met the graduate profile and so this can become more difficult with courses made up of parts rather than being delivered by the institution itself.

Future curricula

Open digital resources and courseware accessible through the Internet create the opportunity for institutions and faculty to offer a wider variety of new learning experiences at lower cost. These resources can also be used by students independently for self-learning. The respondents were asked about potential implications of the availability of OER and MOOC for the revision of curriculum and the system of teacher training.

Open content and curriculum change

Almost a half (48%) of respondents shared fully or to a great extent (16% and 32%, respectively) the opinion that the introduction of OER triggers modification or even reform of curricula. More than a third (36%) of respondents shared this opinion to some extent, 8% to a small extent, 9% replied that no curriculum reform is needed.



Many respondents believed that traditional curriculum was rarely adequate to the use of open resources and should be revised so that HEI could be competitive and their graduates would be successful at the job market.

Curriculum reform is required to adopt the development of digital open courseware and resources. We should accommodate as much digital open courses and resources for the purpose of teaching and learning. This practice would enrich the teaching and learning experience.

Based on the epistemological ground, availability of the learning resources and the new pedagogical approaches, there is need for curriculum reform.

The need for reform is in the delivery mode which will dictate the instructional design of the course.

If an institute adopts digital open courseware and resources, certainly it should make some curriculum reforms. Curriculum should follow the new changes.

Knowledge in a digital society is changed, acquiring knowledge involves new processes, and new knowledge is appearing. This leads to a need for new curricula.

The reform is needed to match the need of the students and the institution's policies and requirements.

The curriculum needs to be designed in a way that actually makes it responsive to and accommodating the use of digital content.

We need to modify existing curriculum so that it could incorporate open courseware. It needs to be managed to assist those who are not using online resources, and perhaps even mandated to ensure it happens.

The reform must also include more innovative ways of how assessment should be designed, conducted and assessed.

I think it is necessary so that curriculum become more student-centered and fully accessible.

Often the respondents stated that the regular update of curricula was needed to ensure that graduates have acquired the skills requested by labour market.

Curriculum reform should be driven by (a) the needs of society and the workplace, and (b) the coherence, credibility and currency of the program.

The existence of OER/MOOC cannot be ignored forever, but the need for curriculum reform will first come from an evolution of the needs of the enterprises and the socio-economic world, which could use these resources at workplace and hence oblige an evolution of what remains under the umbrella of higher education.

No – because of the “development of digital open courseware and resources”, yes – because the curriculum does not reflect the required competences into the market at full.

Basically and mainly, curriculum reform is required due to syllabus, which should meet the quality need of the job market, rather than ICT.

Other respondents expressed their confidence that the curriculum should be revised, but not reinvented or reformed. The process will take time, might differ for different disciplines and should be gradual.

Step by step changes are coming gradually, enough for effective using of ICT and open educational resources. Time for teachers and students is needed to be familiar with innovations, so fast change in rules is not good in this case.

Yes, blending a curriculum requires careful analysis of how and where synergy can be obtained through incorporation of online methods. This analysis will result in a different conclusion for different disciplines, topics, levels and student populations.

Reform is the wrong word. Curriculum should be applicable to all delivery systems. This requires understanding of the similarities and differences and creating a simple prototype for instructors to use. Such a template would provide multicultural students with a consistent delivery format in which only the relevant content varies...

It needs to be fit for purpose. Where the teaching and learning objectives necessitate development of digital courseware and resources and the curriculum is preventing this, the reform is necessary, otherwise it is not.

A number of respondents mentioned that curricula should be revised on a regular basis and its revision should not be necessarily stipulated by the changes in technologies or content formats.

Curriculum reform is required continually based on changes in everything, not just due to these development.

The main curriculum reform is required because of outdated and poor pedagogical practices, not because of technological developments. Technologies can help with finding solutions to the problems creating the requirement for curriculum reform.

Open resources and courseware are a great resource, but they do not change the content of subjects.

Some respondents believed that the change in the format of the content would have no impact on the curriculum, but rather on learning design.

These developments will not necessarily lead to curriculum reform but they will lead to changes in how students acquire knowledge and skills relevant to particular curricula.

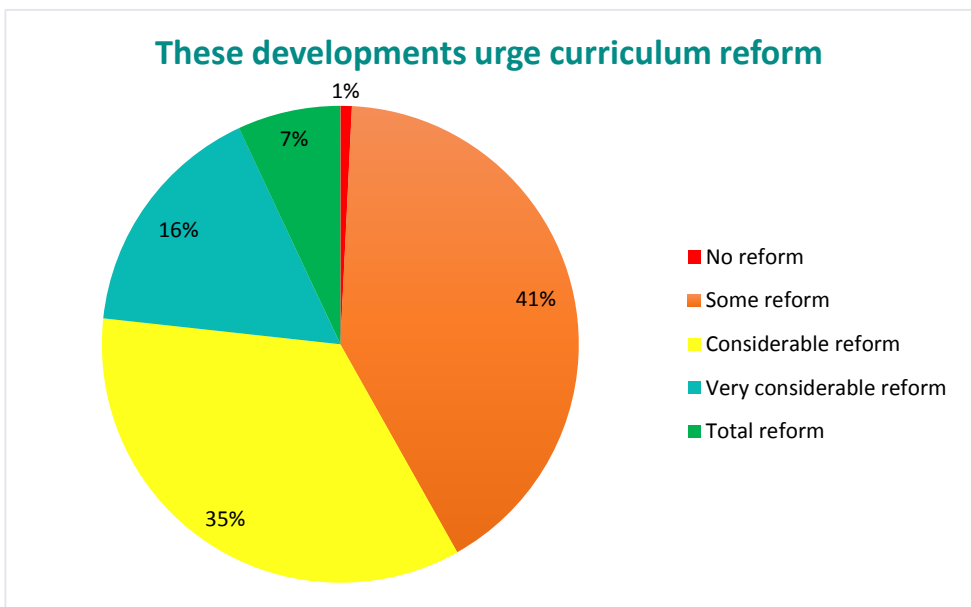
I think that excellent curriculum based upon well expressed learning outcomes and constructively aligned assessments is delivery mechanism agnostic.

Curricula are only supposed to change to reflect new research developments in a discipline, e.g., in physics, the discovery of a new elementary particle may result in a change in the particle physics curriculum. However, curricula are supposed to be platform-independent.

A curriculum always has to be updated both content-wise and in delivery options.

Fast developing technologies and the revision of curriculum

As to the impact of technological development on curriculum proved that 23% of respondents believed that total or very considerable reform was needed, 35% expected considerable reform, 41% suggested that some reform is necessary, while 1% did not expect any changes in the curriculum.



Many respondents believed that the changes are needed, in particular, due to the changing needs of the labour market, e.g. increasing request for ICT-skilled employees, but the process would take some or even long time.

Curricula must address not only the knowledge and competences of a given moment, but the ability to learn and act in a changing world, learning to learn continuously, learning to acquire new competencies continuously.

Immense changes in technology during the last decade have forced educational institutions to rethink their approaches.

Much conceptual knowledge will remain and change slowly. However, more superficial knowledge and information will change fast. We need to find the right balance between the two types of knowledge, but universities will always have a big share in conceptual knowledge.

Existing practices do not change in the short turn, in the wider field, also around educational institutes that work with graduates. Practices will change slowly, so the urge is not that imminent.

Other respondents stressed that curriculum should be updated regularly for some other reasons than those related to ICT, including those related to needs of the economy. Those respondents, who believed that the change was not needed, stated that vice versa ICT should be tailored to curriculum.

Curricula have always been changing and adapting, as technological development speeds up so will the rate of change in curricula, but this is nothing new or radical.

Technology doesn't shape content itself, it has affects only on the way of delivering content. However instructional methods and techniques should be adapted also to online environments for fostering collaboration and cooperation.

The content of curricula does not need to change. ICT could be tailored to current curricula.

Technologies only lead to the change of tutorial forms, but not to the contents.

It is not the content of the curriculum that would change but the way we deliver education. The way we teach and approach learning will change dramatically.

Not necessary to change curricula – better to change the way of teaching / training.

Technologies serve education only as tools, which play second role as compared to the requirements of the job market for fast change of the contents of curricula.

The content of curricula must be developed to cater the changing needs of future generation, industries and workforce.

Actually, it's not so much the evolution of the technology which will now impact HE but the evolution of the economy (cost of the technology, cost of the development of courses and other resources, business model of higher education)

...where the requirement to change the curricula is based upon pedagogical and work-related outcome.

Some respondents mentioned that the need for curriculum change might differ for different disciplines.

Technology shapes education to some extent, the main concern is specific content and it is not affected by technology. Thus, technology is only a tool not the purpose. Only if you are teaching technology itself the curriculum needs change. Moreover, design of instruction, instructional methods and techniques should change in parallel with the changes in technology.

Even in the technological fields, some topics are still fundamentals, and do not really change a lot over the course of time, but many other subjects change substantially each year. It will be a challenge for all institutions to better adapt training of their students to all these updates to avoid teaching them already obsolete skills, and may be even provide them a way to remain updated even after achieving a degree.

There is no one-size-fits-all approach. Curriculum reform is highly discipline-specific.

I think this will depend on the field of study with ICT and sciences leading the way.

I really hope so, as I teach in the area of technology, so it drives everything I do – other discipline areas might be slower and need nudging.

As for ICT, it seems to evolve faster and faster. Curricula content related to ICT will have to change at a similar pace. Other related fields will also have to. In other fields, the content will change faster to accommodate the changing delivery modes.

Respondents provided many suggestions for the ways the curriculum contents could change to adapt to fast changing technologies and use new forms of teaching and learning. Some suggestions were focused on the changes related to future needs of the labour market.

Curricula have not adapted yet to an age of ubiquitous computing (and hence ubiquitous knowledge). This rebalances knowledge vs skills debate in favour of teaching more skills, and less memorized information in curricula.

Rather than universal and generic education, more career-specific skills and attitudes will penetrate curricula and even escape from curricula. New institutes will emerge - they will offer services to students to complement their university milestones.

Each subject is impacted by digital technologies, so every curriculum has to evolve. Moreover, digital competencies need updated curricula. And the curricula must be adapted to the new forms of teaching and learning.

More technology and work-related technologies specifically need to be focused at HE level.

Due to digital age some disciplines lost their actuality, and so many professions appear so rapidly. Curriculum has to change due to demands of labor market.

Many experts stressed that it is important to ensure that the new curriculum is flexible.

Greater flexibility and trust in the professionalism of teachers who need to be networked and collaborative so that they could be open to change.

A more flexible curriculum that is also shaped by students themselves and in which teachers continuously change/reflect on the content of their courses and methods they use.

Curriculum has to be flexible to take into account individual demands. Formal and informal (nonformal) results have to be approved and shown in transcript and diploma supplement for students' motivation and employability.

Some respondents stated that the new curriculum should be oriented towards more personalized and active/interactive learning to acquire 21st century skills.

Redesign of curricula and instructional design activities for each course are needed. Moreover, instructional design for autonomous/personalized learning should also be offered to students.

Higher personalisation – development of self-regulated learners. Universities need to approach learning as a lifelong endeavour. The four or three year degrees are a starting point. Increasingly we see students taking second and third degrees. MOOC clearly highlighted the need for well-developed further education – not necessarily a replacement for a first degree. Lifelong education that aids career development and on-the-job tasks.

Wider variety and smaller blocks/modules for study, information may be available via “unbundled” modules, etc. Teaching practices will vary considerably with more self-paced practices, equally more development of peer-to-peer learning practices.

Learning methods: more online, more personalized, more active learning, more in contact with the society.

Reforms from passive to active learning, from theory only to combined theory and practice.

We need curriculum that is technology-inclusive within its content body, as well as utilisation of technologies in the teaching and learning delivery support. Flexibility and interactivity should be more pronounced in the curriculum rather than passive learning methods.

The roles of instructors and students shall be changed. Students shall be much more active in the course of learning.

There is a need to make the curriculum more interactive. Students with disabilities including those with learning difficulties have to be fully included. Learning content has to be availed in different formats.

More focus on operations that computers cannot perform very well and more focus on knowledge building and other 21st century skills like (online) cooperation, self-regulation of learning, knowledge network building, digital literacy, etc. Capitalize on new ways of teaching complex matter (visualization, online experimenting and manipulation of abstract learning objects, serious games, etc.).

Some respondents stated that the curriculum reform would require changes in methodological and pedagogical approaches and formulated their vision of the changes that are needed.

Objectives and content will evolve, but a more difficult issue is the reform of the teaching and learning approaches. They may just evolve as a result of the global evolution of the ICT society or reforms will push them. Reforms needed: generalisation of MOOC everywhere – the content is delivered by lectures, flipped classrooms, revisiting the balance between initial and continuing education, personalized courses (way of collecting ECTS).

Implementation of psycho-pedagogy that will legitimize technology-based learning.

Many experts stressed the importance of revising the assessment and credentialing strategies.

A much sharper focus on authentic assessment and competency-based learning with less time spent on creating and delivering content.

Most reform is needed in the ways that students are assessed as this provides the evidence for any evaluation. Assessment should drive objectives, learning methods and content, not be an afterthought.

Availability of high volumes of content has refocused teaching into facilitating learning and not delivering content. This requires different types of assessment strategies that are used for facilitation of learning rather than testing content knowledge.

Proper learning assessments and shared, yet customized goals.

Diploma for one year or for a complete course are no longer useful. The concept of nanodegrees is more “agile” and better adapts to the needs of companies.

Also the respondents expected that the changes in the curriculum should be linked to the increased volume of the content.

Complete transformation is difficult to fully envision, but some of the key aspects include learner agency, ubiquitous access to all the world's knowledge, co-authoring and co-researching by peer groups at all levels of education, self-organizing teams around emerging problems and challenges, automated feedback and recommendations, machine assisted decision making, scoring, grading, adaptive curriculum and assessment systems integrated with the library and utilizing OER materials, and "learning experience" (not "content") authoring systems that integrate people across disciplines and with a variety of production skills.

Teachers should consider the tremendous resources available on the Web and the availability of the digital devices to build their own content. Learning strategies need to reinforce new teaching methods where students become the center of learning. Evaluation methods need to be considered in light of the development of technology where students can monitor their own learning progress. Content needs to be more realistic and should be based on real world problems.

Contents: gradually reform, but within 10 years a lot will have changed. Integrate new important topics such as big data and sustainability in the curricula.

Making students able to find, select and use open educational resources throughout the curriculum (not only a skill course) and make teachers aware of what this means for their knowledge and role.

Changes proposed by the respondents cover a broad spectrum of different aspects of the educational process, from curriculum and learning design to pedagogical approaches, learning methods and assessment.

Redesign of courses, plans for hours and semesters, and even the duration of programs. Furthermore, alternative online assessment (e-assessment) approaches should be integrated into the new curriculum as well.

The curriculum reform should prepare students to resilience and contemplation in the 21st century. The methods should be based on socio-cultural and new pedagogical approaches. The assessment process should be based on formative assessment and self-evaluation.

Learning with technology should be transversally present in objectives and learning methods. Learning methods shall rely more on collaboration and user-generated content.

Re-designing curriculum in a way to create techno-pedagogic curriculum.

Curriculum reform is needed only in terms of learning methods at present. This starts from meta-cognitive skills, attitudes and competencies and expands towards acquiring problem-solving and production/design skills. It needs to be specified per discipline.

More competencies-oriented curricula, curricula which can be adapted to different learning methods and digital environments (for instance, the curriculum for a MOOC is not the same as the curriculum for a regular course, and an online course must have a different curriculum as compared to a traditional course).

Shift towards student-centered learning models and methods.

Curriculum has to be flexible to take into account individual demands. Formal and informal (nonformal) results have to be approved and shown in transcript and diploma supplement for student' motivation and employability.

Curriculum reform should be formulated with regard to on accommodation of appropriate pedagogies, leveraging digital technologies, learner's participation and encouraging engagement, providing students with persuasive content.

Objectives need to be based on learning outcomes. Learning methods need to be based on student engagement in learning. Content needs to be supported by practical learning resources where more space will be available for teachers to interact with students.

Rethinking the boundaries of undergraduate and postgraduate degrees, and the concept of academic specialization.

There needs to be less of a "tick the boxes" approach and more focus on learning to learn and then being able to apply these skills to solving problems, carrying out tasks, etc. My attitude toward current curricula is that they are too rigid and are heavily weighted toward compliance rather than the attainment of "lifelong" learning skills and capabilities.

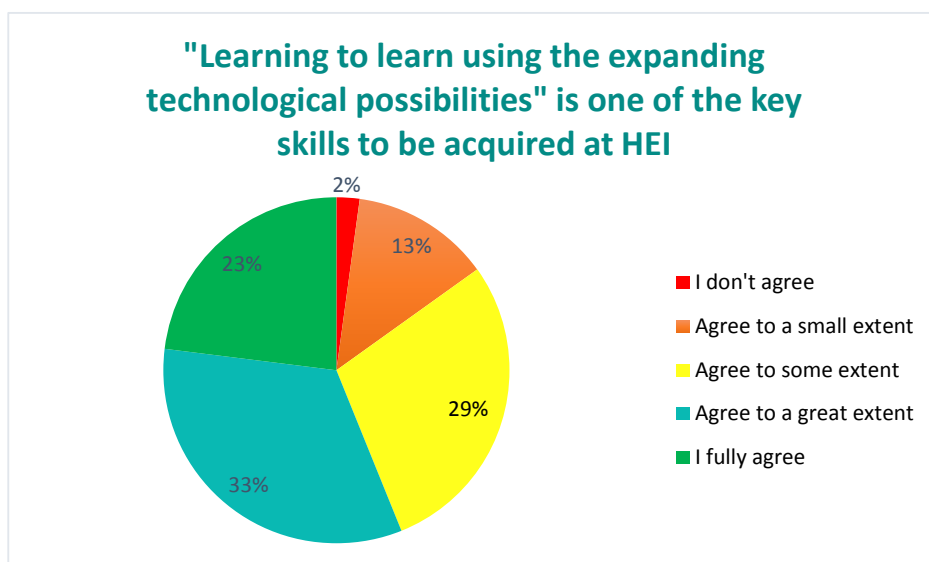
Curriculum should be designed to produce metacognitive learners... learners need to be taught how to be motivated and take control of their own learning in the subject area.

Interdisciplinary and cross curricular application of content/material.

More language integrated learning, more emphasis of 21st century skills into other content domains, more interdisciplinary work, more focus on knowledge building in networks, more focus on digital editing skills and digital literacies (including programming), but also on critical thinking in online learning domains.

"Learning to learn" as one of the key objectives of higher education

Most respondents agreed that learning to learn using the expanding technological possibilities should be considered as one of the key objectives of higher education. A majority (56%) of respondents agreed with this statement fully or to a great extent, 29% of respondents agreed to some extent, 13% agreed to a small extent and only 2% disagreed.



Many respondents emphasized the need for lifelong learning, continuous education throughout the life, which requires understanding rather than mastering of certain technologies in order to be able to switch to new technologies, when the technologies that are considered advanced today would become obsolete tomorrow.

Learning to learn should always have been one of educational goals. Regarding “knowing the expanding technological possibilities” we should prevent that we teach instrumental aspects of technology. It is better to learn to understand technology and how it developed than to know all kinds of tools.

We are in the information age and all learners should be aware of all the capabilities and possibilities that technology offers to them.

Because of the role of ubiquitous technology at the leading edge of knowledge, in social life and in the global evolution of society, higher education’s role must fully embrace “learning to learn using and knowing the expanding technological possibilities” as a key pillar of its role in creating, curating, and communicating knowledge.

Graduates are expected to operate in a technologically rich world and therefore should have developed sound experience to handle this. However, this is not sufficient given the rapid rate of change and therefore graduates need to have a more profound understanding of learning in a changing environment. They need to become lifelong learners. This is not a new idea but perhaps a more important one given the rate of change.

Students need to understand how various technologies can be used to aid their learning endeavors. This requires scaffolding and practice.

I said “yes”, but I believe that this has always been the case. It is a myth that “lifelong learning” is something new. Few effective professionals have ever been able to simply deploy skills learned through higher education programs repeatedly throughout their careers. Technology does accelerate the pace of change, but flexible thinking is a long standing attribute of effective professionals.

Technologies, just like skills, can become obsolete. Technologies and skills are deployed in a context. Some may be specific to one context, others to many contexts. The key is fostering inquiring and capable minds that can adapt as context and skills change. Different technologies might help or hinder lifelong learning.

Many technologies and their extended uses are required in the workplace and students need to enter the workplace prepared.

Ideally higher education moves students onto a path of life-long learning. Students unfamiliar with technology will need to learn. However, there are different levels of needs to know technology depending upon the individual’s role in the society. We could say that learning to use a computer (keyboarding, file locations, use of applications such as a word processing program) would be the base. But the amount and type of knowledge escalates with a person’s role changes from a user of technology to being a creator of software, hardware, devices, etc...

The easy response is “yes”, actually this general statement (which by the way is not new, learning to learn has an old story) hides a very high complexity. I would prefer to consider the problem of the necessary ICT education and digital literacy from K-12 to HE.

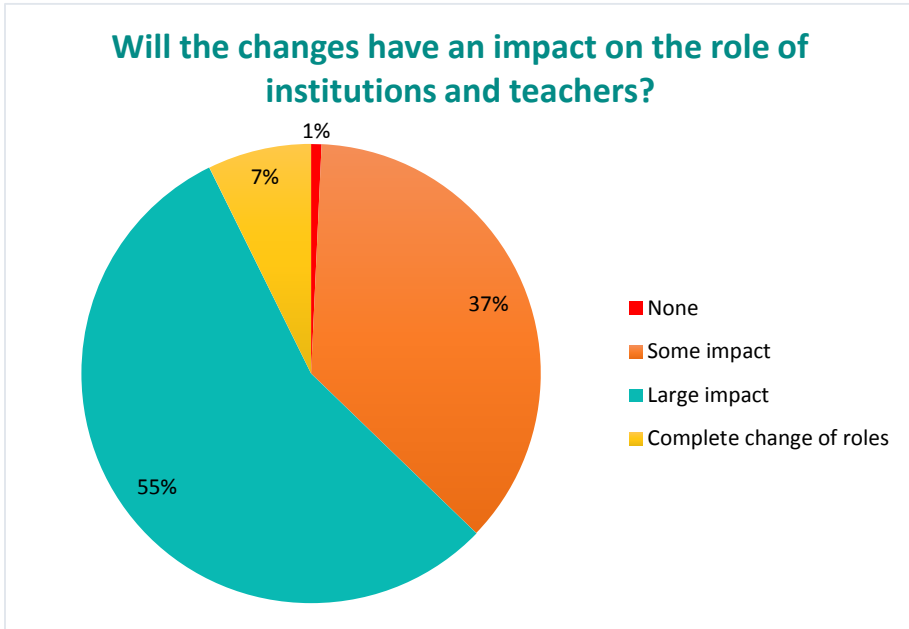
Some respondents replied in the context of their considerations about the mission of higher education. They argued that the concepts and the subject matter are more important than “learning to learn using technologies”.

Technologies are only tools but cannot change the results and efficiency if higher education has not changed its concept, mechanism, organization and methodology.

Higher education is more than just technology and we can’t make it all about technology or we lose the very soul of the university experience. It is not about training people to use machines. It is still about the disciplines and multi-disciplinary undertakings. Technology simply adds value to that. It is not the core of the learning focus and should never be.

New missions of teachers and institutes

A majority (55%) of respondents agreed that the curriculum reforms would have a large impact on the role of institutions and teachers, of them 7% even indicated that a complete change of roles should take place. 37% of respondents saw some impact on the roles of institutions and teachers. Only 1% suggested that the changes would not have any impact and the roles of teachers and institutions would not change.



Changing roles of teachers, faculty and educational teams

With regard to the future role of teachers many respondents mentioned that teachers' function would transform into the role of facilitators of knowledge, guides, mentors, e-tutors, counselors and team leaders.

Teachers should become guides, coaches and excellent users of new (re)sources. Focused on co-creation with assistance of the best new available technologies.

Teachers need to become "information guides", mentors and guides, and less lecturers.

Solution providers for designed learning environments.

The role of the future teacher would be more of a facilitator of learning with technology-enabled skills focused more on learning and less on teaching.

Becoming e-tutors having the skills defined for digital citizenship and competencies for 21st century.

Now they need to be an organizer of information, pace the material, structure the learning environment, motivate the student and do related tasks to collaborate with students in getting education.

Not only deliver or transfer knowledge, but be "pedagogical engineers", "digital resources designers", "digital courses designers".

Yes as “ex-cathedra” lessons will disappear, teachers have to become facilitators of learning and they need skills to create and animate sessions in a collaborative way. They have to coach students to guide them on how to learn better.

Teachers will need to learn how to build relationships in virtual environments. Collaboration, facilitation, agility and adaptivity will be key skills. Knowing how to teach students to learn how to learn.

Facilitation skills, curriculum development, educational technology.

They need to recognize that they are learning partners with their students rather than deliverers of knowledge as before.

They need to learn how to use this technology and know what we mean by ePedagogy. At the moment people are ... trying to recreate the four walls of the classroom online.

More facilitation and guidance will be needed from instructors. They will not just deliver information but design and provide an effective learning environment for each learner to guide their learning process, and give feedback from time to time while monitoring the progress. Faculty should have an innovative vision to support their instructors. Educational teams should be using latest technologies and innovations to keep their students up-to-date.

The respondents suggested that teachers should be competent in both their disciplines and technologies. Some of them expected that teaching would become a team activity, teachers and other staff might acquire new roles and tasks in the future, but they should work in teams and there should be a distribution of labour among them.

Some teachers should either specialize in producing teaching material, in a manner similar to current textbook authors, but more oriented to digital technologies, or in becoming counselors and team leaders for their students, helping to clarify their doubts, providing support, coordinating laboratory work and teamwork, while leaving most of the actual explanation and study to the new tools.

Future teachers will need to work in teams to interact efficiently across technological platforms and to develop coherent programs of study that guide students.

Different skills for different cases in teaching are needed: minimal level of ICT is necessary for all teachers, high level is needed to be “coach”, “moderator” and “mentor” of educational process to activate self-education of students. The highest level of ICT is needed for professionals in ICT and ICT for teachers.

The team dealing with online courses will include a methodologist acting as a mediator between teachers and IT team.

Additional tasks will include research, design and revision of curriculum and technology integration.

Faculty and educational teams will need to include multiple specialties and to operate more flexibly.

Collaboration will become a habit rather than exceptional practice. Communication, monitoring and assessment will increasingly become personalized to individual learners, which will require an increasing familiarity with – and use of – data and analytical tools. The very notion of “teaming” will be reinvigorated within higher education institutions, from its current meaning of “a group of individuals within a common discipline” to a true community of educators working with and for learners.

Teaching teams will be interprofessional to facilitate learning that is not discipline specific but may incorporate a number of discipline areas and will be more problem/challenge-based. Developing relationships with students and with teaching teams will be a priority.

The faculty and supporting staff are expected to play their role in facilitation and creation of encouraging working and learning-intense environments.

The role of the faculty and educational teams is to create a suitable working environment for teachers and implement their ideas.

Faculty will have to multitask, may have to provide human touch/elements in virtual teachers. Teachers will also come from other organizations/institutions.

Faculty has to stay the “guarantee” of the quality of knowledge and develop collaboration with companies in order to offer courses well fit to their needs.

Faculty and educational teams should act as change agent in the institutions.

Faculty and education teams should become designers, coordinators, directors and organizers of the learning process, become partners of students in creative learning process.

They need to create an environment where teachers and students can be flexible and adapt more quickly.

Faculty has to manage the process of change elegantly to avoid resistance.

The best way for faculty to go about what is needed is to work collaboratively and across disciplinary boundaries. This does not happen on many campuses, but is needed in order to make instruction more relevant, authentic, and applicable to specific contexts in which students will ultimately deploy knowledge.

The respondents provided various suggestions for the measures to be taken at institutional level to support the change of roles.

Institutions themselves should reinforce their certification role, and concentrate on the practical, on-the-job part of technological training, as that is the part that could not be covered by online training.

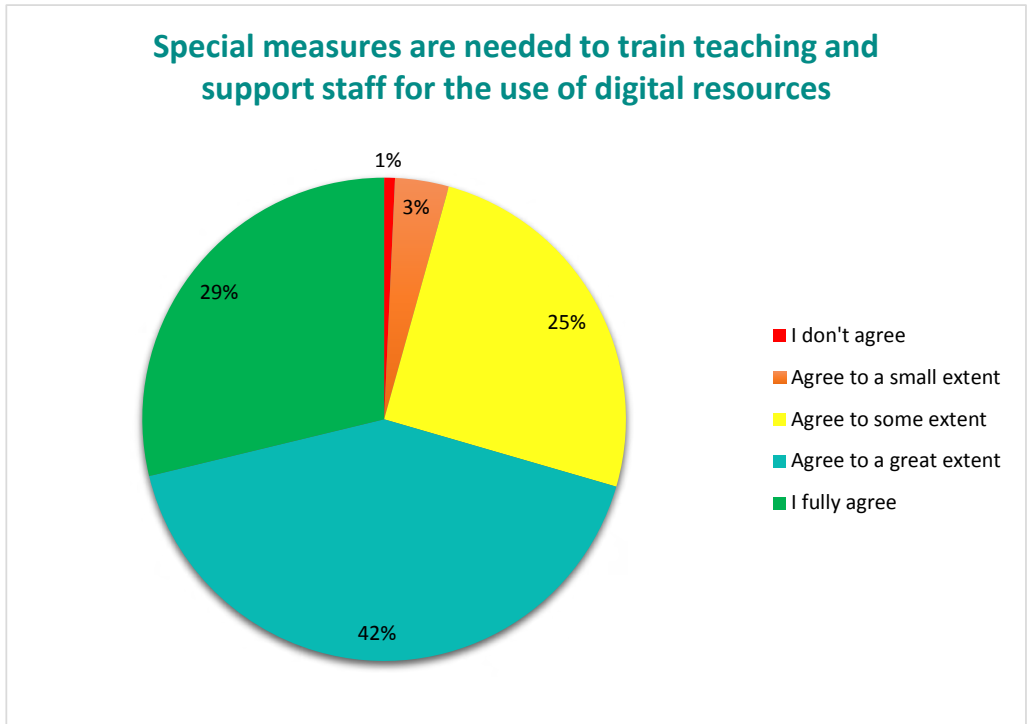
With the curriculum reforms, the education model would move from teacher-centric to learner-centric. There would be more opportunities for personalised learning. Teachers would be able to offer their services on the basis of needs of learners. They can measure the learning outcomes through the most advanced technologies. Motivation, training and infrastructure are the key provisions, which would be needed to make the role of the teacher effective.

First of all to motivate training staff to use technology and change the way of training not to follow the old teacher-centered education. The competence-based learning and active learning have to be in the focus.

HE must create and establish the culture for innovation and participation to meet the demands of stakeholders and global competitiveness based on quality of education, and social responsibility for being a hub for lifelong learning for all...

Special attention to infrastructure, applications and software to facilitate these new teaching and learning activities.

A vast majority (71%) of respondents agreed fully or to a great extent and shared the opinion that the introduction of OER necessitated retraining of teaching and support staff; 25% agreed to some degree, while only 3 % agreed to a small degree and 1% disagreed.



Almost all experts indicated an urgent need for retraining of teachers. Many respondents expressed a very deep concern about the fact that some teachers are still not digitally literate and not motivated to improve their ICT skills, though the new generation of teachers is better prepared to the use of ICT in the educational process. The respondents mentioned such barriers to ICT literacy as the lack of time and even fear for the new technology. Continuous training should focus not only on the use of digital resources, but also on production of digital content. Special attention should be paid to motivation and encouragement of teachers.

Teachers are mostly not digital natives, thus they need to be trained to do browsing and selecting quality digital resources as well as contextualizing and integrating the open resources into their teaching curriculum and materials.

Yes! Too many are continuing to teach the way they were taught, while there are innovations that others have used to support learning.

Some teachers and staff are still not good at using digital open courseware or other resources. So they need training in order to meet the new demands.

Teaching staff should be strongly trained not only to understand the technological aspects of digital devices, but also and mainly to adopt the new pedagogies that became possible (and necessary) by digital technologies.

Part of the staff is ready but another part needs training and more important – motivation and understanding.

Staff should be trained to acquire the necessary skills for using digital open courseware and resources.

Creating content is no longer limited to writing a textbook and preparing lecture notes. Immersive learning experiences require the capturing and incorporation of information by a variety of devices and in a variety of formats. Content creation therefore is no longer an individual experience. Teaching and support staff will need retraining for mastering new technology and infusing the knowledge captured into creative learning processes.

Yes, using online methods requires some technical skills but (paradoxically) also requires significant retraining to acquire face-to-face teaching skills.

Most faculty members need to take training because they are conservative to some degree and have insufficient competence in using digital resources.

This works best when it is part of a general staff development programme. As the “word” open and the “sharing” discourse can be quite alienating.

Training is seldom very effective. Informal learning from colleagues may be more effective.

It is crucial to ensure that staff is not only ICT competent but also believe in the opportunities provided by ICT for the delivery of education (advanced technology and online pedagogy).

This is one of the major impediments in this context. If staff can't or don't know how to use e-learning approaches they won't use them. Therefore appropriate, relevant, and “just-in-time” training and support is essential if we are serious about e-learning to play a more substantial and important role in the future of tertiary education.

Staff need professional training in order to be able to develop, deliver (teach), provide student support and even assess these courses.

Faculty members are not all conversant with the emerging technologies. For some it is still a challenge to even participate regularly on LMS for student support.

Only a good face-to-face teacher can become a good online facilitator or teacher. Two types of training are required: 1) How to become a “learning process facilitator”; 2) How to use digital tools to help students solve their learning problems and reflect about their learning.

Retraining teachers is a key for the success of the aforementioned reforms, yet not enough understood and taken into account by policy makers who consider that equipment is enough.

Some of the respondents emphasized that the retraining should address not only technological aspects, but also those related to pedagogical approaches because the use of ICT raises pedagogical issues. In addition, some respondents stressed the role change that should take place, from teacher to guide/coach to a member of a team of experts producing digital learning materials.

It is noteworthy that the respondents raised an important issue related to intellectual property rights and openness.

Staff need greater awareness of rights management (e.g. creative commons), better understanding of digital practice.

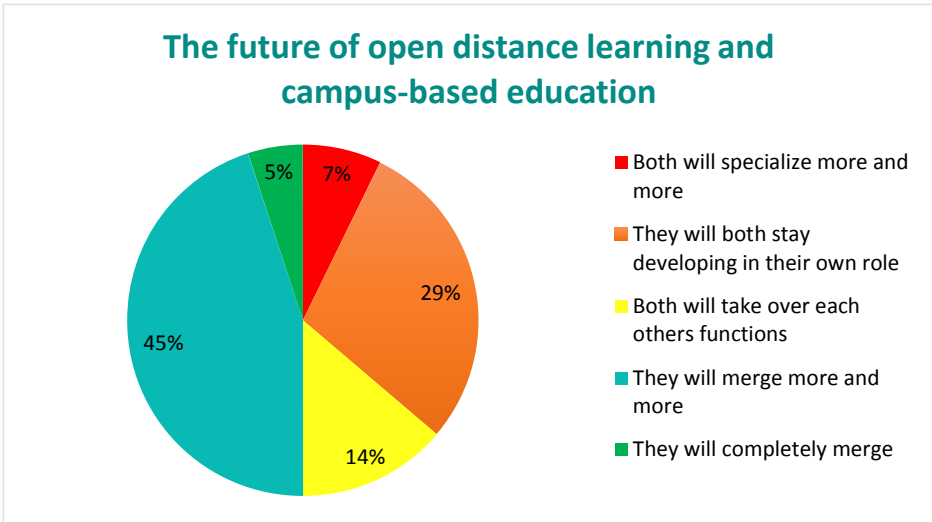
Especially copyright issues (how “open” is “open”), but also more (digital) information literacy (evaluation of trusted sources, cutting and pasting of digital material, editing online content, etc.).

If we want open students, we need open educators.

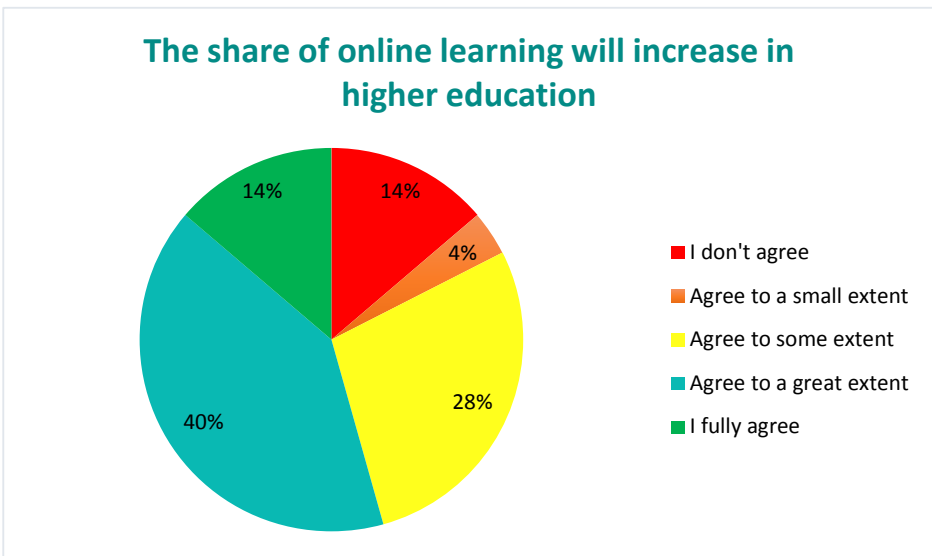
The proliferation of these new resources raises new problems about copyright (and copy left!), which many educators are not yet conversant with.

Future of institutions: online distance learning and campus-based learning

A half of respondents expected online distance learning (ODL) and campus-based learning (CBL) to merge (of which 5% believed that they would merge completely), 14% expected them to take over each other functions, 29% expected them to keep their current functions. Only 7% expected that ODL and CBL would become even more separated.



A majority (54%) of respondents fully or to a great extent agreed that the share of online distance learning would be growing in the coming years, 28% agreed to some extent, 14% – to a small extent, and only 4% disagreed with the statement.



The majority of respondents who agreed fully or to a great extent expected that the growing share of online learning in higher education would ensure more flexibility for students, provide an opportunity to study to those who cannot attend classes for mobility or other reasons and could compensate for the lack of teachers.

Online content is easier to update, more economic, more easily accessible, and allow approaches that were not possible before, so users and peers pressure will likely push institutions toward a wider use of online materials.

Online learning will become popular due to several reasons: lack of classrooms, lack of sufficient number of instructors, changing nature of young generations' way to learn, etc.

Rapid advances in technology have made information ubiquitous. At our institution, online learners are the fastest growing cohort and all students expect to use online learning environments.

On top of lack of space and teachers for a growing population of students, one must acknowledge that today's students are digital natives and they require higher education to be offered digitally.

The appeal of convenient, flexible, and just-in-time learning experience is growing exponentially in response to the requirements of the marketplace.

People need freedom in their choice of learning around different geographical locations and different modes of learning.

For many reasons, I would expect online learning to grow in higher education. The main reason is the growing expectation for 24/7 availability of all services, especially among the learners who are not full-time students – a growing segment of the higher education population. This does not threaten “brick and mortar” campuses very much. There are other to those campuses (their inability to train graduates who can actually get jobs, for example, and the rise in the number of substandard degrees).

The trend in and outside our schools is that of increasing technology usage, not only by students, but by academic staff as well.

Convenience, global reach and reduced needs for costly physical infrastructure is already leading higher education down this path. The early indicators are things such as open plan offices to save space/cost, and more online delivery and communication even for people in the same buildings!

The appeal of online learning is clear – the costs are offset for individuals, as they can keep working whilst studying in a time or space that suits them. Timeliness and flexibility will ensure that the numbers of students who select this option increases. Our own experiences are clear in this area, we have face-to-face offerings and full online enrollments and the ratio is 1:5.

Look at my own institution as an example – in the middle of the Pacific ocean serving rural and remote students with limited access to internet and still we are running and jumping at online learning.

Online learning is particularly suitable for distance education environment, if our students have access to the necessary technology.

Many of the respondents suggested that a proper balance should be found between online and face-to-face learning, while often CBL includes face-to-face and online tutorials and is delivered in the blended mode. Some respondents raised the issue of quality assurance.

Online and especially blended/flexible learning will continue to increase dramatically.

Online comes to take over and complements face-to-face learning. It will support and encourage the system...

Yes – but probably largely in blended forms rather than pure forms, so it will be used alongside with face-to-face formats, rather than instead of them.

Given a choice most students want a significant amount of face-to-face interaction supplemented and complemented by online learning. Our students still want offline resources (books, etc.) as well as online ones - most would like more face-to-face events and yet the logistics of distributed students make this difficult to do – and most study with us because their circumstances make it difficult to study at a conventional university...

Yes, it may already be happening in postgraduate courses, and with rising costs of face-to-face instruction it could be introduced in some undergraduate courses too.

People are now more online. Traditional delivery of lectures is now becoming obsolete. Online and on demand lectures with face-to-face workshops or online tutorials are becoming more commonplace.

There was a number of advocates of face-to-face learning among the respondents.

Online learning can never replace face-to-face tutorials, when in face-to-face tutorial of a professor, you can have eye contact with the teacher, and you will also be “called back” when you are absent-minded. But it will never take place in online learning.

Students still need to communicate face to face with their teachers and classmates especially at the undergraduate level.

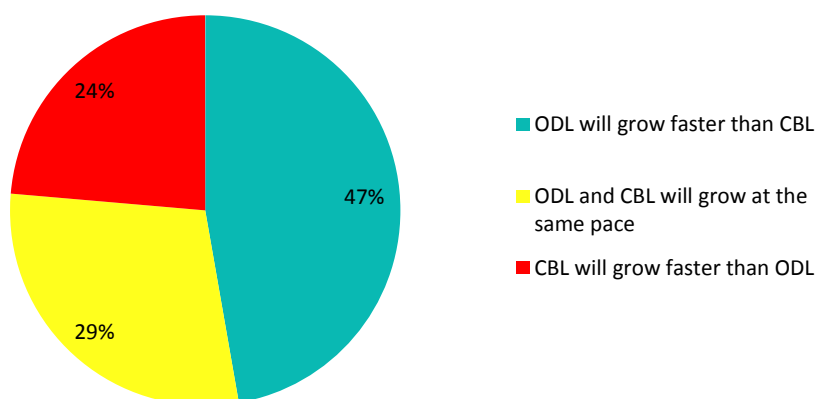
Online learning is a useful addition that can allow face-to-face teaching and learning to be more effective (more personal, active and interactive). The power lies in the combination.

There were some hesitations about the spread of ODL due to the distrust to this form of delivery among academics and students.

The data in our country suggests fully online learning has a small and static share of provision. In the US, with a much more aggressive approach from regulators and institutions alike (e.g., Florida has mandated levels of e-learning provision) the share is likely to increase. Internationally it will depend on key players like South Korea, Singapore, Germany, etc., if this form of delivery is to grow significantly. The reality is that there is still large distrust to this type of delivery... These major hurdles mean outside of isolated areas online learning is not likely to be a major part of provision.

Almost a half (47%) of respondents expected online distance learning to grow faster than campus-based learning, 24% expected the opposite, while 29% expected a similar pace for both forms of delivery.

Which statement on development of ODL and CBL is true for your country?



The comments of the respondents proved that the expansion of ODL is inevitable because it ensured easier access and internationalisation (globalisation), cost saving and scalability.

ODL means a great deal for people over 30 years old, seeking to finish their HE studies or making a double degree. CBL is hardly compatible with family & work.

ODL encourages lifelong learning and flexibility, it allows students to learn wherever they are located and save costs.

Students do not have enough time, they no longer want to spend days on campus attending lectures and studying or even catching up with friends. They now want to spend a minimum time for maximum benefit – if much of this can be done online (at a time that suits them) then I feel this will be the option taken.

Convenience and flexibility of access for learners and access to wider markets for institutions.

The demand for ODL is strong, and our uptake is clearly supporting the concept that more students will select this option rather than campus-based.

There is a growing need for higher education and there is not enough resources to develop physical structures to accommodate huge numbers of students, national policies are now recognising the role of ODL in widening participation in higher education.

Most people need to work to earn a living so ODL is the only way they can use to improve their skills.

The market for ODL is larger than the one for CBL. There is a demand that cannot be fulfilled by CBL, but can be met by ODL.

Many respondents mentioned that both forms of delivery would continue to exist; however, the distinction between ODL and CBL would become less clearly determined, as now CBL can include face-to-face and online activities. Many respondents insisted on the importance of using blended mode.

Both types of institutions have their own business model, and will evolve accordingly.

Both are necessary and enrich one another. The teacher will keep an important role as a mediator between the students and the knowledge.

None of the options provided are predictable in my country and the two categories are not distinct. Current HE providers run MOOC so already have merged functions. Regional and campus-based universities run significant distance/online programs. Rationalization of HE providers will depend largely on government funding models as this is the major funding source.

Mostly the best education is face-to-face with e-learning support, because ICT restrict the opportunity to deliver some teachers' emotions, despite huge new didactic possibilities of ICT. It's true that distance learning is "education for all", very useful for poor people, for working people, for people with disabilities, for people living far from educational centers, but the quality of education is different.

Best of classroom and best of online will be blended together to produce the best learning outcomes.

Some respondents mentioned strong resistance of institutions against promoting and providing online learning, in particular, because the number of students on campus decreased. Another obstacle for wider penetration of ODL is the conservatism of HEI. One more reason is students' preference of face-to-face learning.

Higher education institutions are conservative and reluctant to change rapidly. ODL are not always considered credible by serious traditional institutions.

Online programs are still not valued as much as traditional ones. Online graduates have lower chance to find a good job.

Lack of institutional and governmental interest – power of the lobby of the education sector.

Many people still prefer to have face-to-face meetings, while there are people who can only access higher education through ODL.

Drop in overseas student numbers coming to campus.

In our country, only those who fail entrance examination for CBL HEI will go study in ODL. One cannot deny the fact that ODL has a lower social status. And ODL is a supplement for CBL. Neither can replace each other.

There are restrictions for conventional higher education institutions to deliver ODL due to some monopoly of the Open University.

Most students/parents prefer on-campus study with higher quality assurance.

CBL has been the main focus for the higher education system.

My institution is conservative. It is skeptical of ODL and ICT, so it tends to be more cautious in adopting learning solely through ODL.

Lack of ICT infrastructure to facilitate teaching and learning in ODL.

Discussion

The next decades promise high uncertainty and profound changes, such as global economic crisis, political, societal and demographic processes, technological development and climate warming. Each of these factors will have an impact on education, on the whole, and on the higher education, in particular. A series of expert discussions and the survey that involved high-level policy makers and education practitioners from all continents were intended to encourage thinking about the future of the higher education and the changes expected due to the use of ICT. The in-depth analysis of the data obtained within the project made it possible to draw the conclusions that would support long-term decision-making in order to create sustainable development models for higher education rather than short-term solutions that would push the challenges in the future.

The future of open content and validation of OER-based learning

The study proved that the majority of HEI are already involved in the production and use of OER/MOOC. Furthermore, both distance learning institutions and traditional universities are actively dealing with open content. Some universities use OER/MOOC produced in-house and externally: whereas many of them accumulated experience in partial or integral inclusion of OER produced by other HEIs in their courses, there are still HEI that use the resources produced in-house only. To foster the use of OER produced in other HEI, national and institutional curriculum and standards should admit the opportunity of localisation of the open content produced externally.

The experts believed that open resources (OER and MOOC) would become an integral part of the teaching and learning processes within the next 15 years. They stated the need for more active collaboration between universities as a prerequisite for the acceptance of resources produced by partner institutions. Other prerequisites are the quality of resources and reputation of HEI producing OER/MOOC.

Many experts emphasized that OER deserve more emphasis, because they believe that the probability of incorporation of OER in the educational process is higher than that for MOOC.

The recognition of OER/MOOC-based learning results is an important aspect of incorporation of open content in the educational process. Though currently most HEI are at a very early stage of recognition of OER/MOOC-based learning results obtained with the use of both their own and externally produced resources (the same is valid for transfer of credits), they have already started experimenting with microcertification (certificates, badges, etc.), and it is expected that within the 15 years from now the existing system of awarding credits will change and credits for OER and MOOC would be increasingly accepted. Since the existing assessment procedures were developed for face-to-face teaching and do not provide appropriate tools for revealing fraud, cheating and plagiarism, which is a major concern for educators, new formative and summative assessment techniques (project-based activities and assessment, digital storytelling, etc.) should be used more widely to assess OER/MOOC-based learning

outcomes. Assessment standards should be harmonized to ensure the transfer of credits among universities within one country or for international credit transfer.

A vast majority of experts agreed that the ICT-induced changes, including those related to the use of OER in higher education, would make HEIs to rethink the systems for awarding credits and to unbundle the offerings and validation of learning results. These issues raise the possibility of fragmentation (or unbundling) of learning activities and credentials, particularly when lifelong learning dimension is concerned.

The system of awarding credits and validation of learning results is inevitably influenced by the requirements of the labour market. Many experts stated that the changes in the system of HE degrees should be coordinated with the labour market needs and skills requested at the job market. A decline in the future labor market need for formal higher education degrees is expected in the coming 15 years, but the situation would be different for different disciplines and professions.

Future curricula

The study proved that there could be different visions of future curriculum changes. The majority of experts believed that the curriculum should be revised in accordance with the widening use of open content and new technologies in higher education. It was stated by some experts that the introduction of OER and fast development of ICT would trigger the modification (or even reform) of curricula. Some experts believed that curriculum should be revised, but not reinvented or reformed. The process will take time, might differ for different disciplines, topics, and levels and should be gradual.

A slightly different opinion is that curricula should be revised on a regular basis, but the revision should not be necessarily caused by the changes in technologies or content formats. Regular update of curricula is needed to ensure that graduates have acquired the skills requested by the labour market.

An opposite approach is that there is no need in changing the curricula – changing the way of teaching is considered to be a more effective strategy.

Those who believed that the changes in curricula are needed proposed the following opportunities:

- New balance between informal and formal learning should be established.
- Curricula must address not only the knowledge and competences of a given moment, but the ability to learn and act in a changing world, learning to learn by doing, learning to acquire new competencies continuously.
- Digital competencies need a more flexible updated curriculum that is also shaped by students themselves.
- New curriculum should be oriented towards more personalized and active/interactive learning.
- More online and more personalized learning, more contact with the society.
- Redesign of courses, plans for semesters and even the duration of programs. Alternative online assessment (e-assessment) approaches should be integrated into the new curriculum as well.
- Expansion towards acquiring problem-solving and practical project-based skills.

- Rethinking the boundaries of undergraduate and postgraduate degrees and the concept of academic specialization.

The changing role of HE institutions

As to their expectations with respect to the quality and costs of higher education, the majority of respondents stated that recognizing the traditional role of HEI as the bodies awarding higher education degree and considering their conservatism and reluctance to change there was an urgent need to rethink the future role of universities in the digital age. The experts mentioned two distinct educational roles of HEI: delivering knowledge to their students and certifying the level of competences acquired by them. The first role is much influenced by the emergence of new formal and informal training opportunities through ICT and will inevitably be modified because universities are no longer monopolists in providing access to high-quality information and knowledge relevant to the postsecondary education sphere. Another role - to verify that students have properly benefited from training and passed proper examinations by qualified personnel - most likely will remain the core function of the higher education institutions, even though the character of the certifications could experience changes in terms of scope, regularity, form of education delivery, which will be necessitated by the up-skilling and re-skilling needs dictated by the labour market.

With respect to the delivery form, it is expected that the higher education ecosystem will be transformed: online distance learning and campus-based learning will merge or take over each other functions and the share of online distance learning would be growing in the coming years. Many of the experts suggested that a balance should be found between online and campus-based learning: the former should include more interaction with the tutor, while the latter should include online tutorials. The majority of experts are proponents of blended learning. Still there are advocates of face-to-face tutorials and skeptics who expected that online distance learning and campus-based learning would keep their current functions and remain separate or even become more separated.

The future role of teachers and faculty

Since the use of OER/MOOC and ICT has resulted in the shift in higher education from providing access to knowledge to providing access to learning, the role of teachers is transforming into the role of facilitators of knowledge, guides, mentors, e-tutors, and counselors. Some experts even expected that teachers would not only deliver or transfer knowledge, but would become “pedagogical engineers”, “digital resources designers” and “digital courses designers”. Teaching is expected to become a team activity: teachers and other university staff members might share roles and tasks in the future. Teaching teams will be interprofessional and may incorporate a number of discipline areas or activities that might be more challenge-based. Relationships between teachers and students are also expected to undergo some change: teachers will collaborate with students, in particular, in joint production of educational content.

Almost all experts indicated an urgent need for retraining of teachers. Future teachers should be competent both in their disciplines and technologies. Many respondents expressed their concerns about the fact that some teachers are still not digitally literate

enough and not motivated to improve their ICT skills, though the new generation of teachers is better prepared to the use of ICT in the educational process. Continuous training should focus not only on the use of digital resources, but also on production of digital content. Teaching staff should be trained to understand technologies, the ways of producing digital content and the mechanisms of functioning of ICT devices. They should also be instructed to adopt the new pedagogies in relation to digital technologies. There are also other reasons for rethinking teacher training, that are not immediately connected to technology but to more general considerations which are sketched in the UNESCO report “Rethinking Education” (UNESCO, 2015).

This is in line with the considerations of most experts who believed that learning to learn using the technologies should be considered as a one of the objectives of higher education and lifelong learning. Training of teachers in this field should ensure that they would teach their students to learn after they graduate, being able to get new skills and master new technologies, when the technologies that are considered to be advanced today will become obsolete.

Conclusions

By the 2030s we expect that the future higher education sector will go through considerable changes and look quite different in terms of the mission and functions of higher education institutions, modes of teaching and learning, pedagogical approaches, student-teacher relationships and the role of teachers. This study was aimed to provide a comprehensive and structured look at the challenges and opportunities brought by the use of ICT and open content (OER and MOOC) in higher education and overview the visions and expectations of key higher education stakeholders towards the future of learning at universities and higher education institutions.

There is a consensus among the experts about the fact that future mission of higher education should be revised due to the transition from traditional societies to ICT-driven knowledge society and knowledge-based society. The role of higher education institutions is to become knowledge centres for the whole society, open lifelong learning institutes. It is expected that the character of higher education will become less elitist and more open. As to the basic functions, it is suggested that there will be a change from content (knowledge) development/provision to content facilitation and skill development, which might include joint production of knowledge with engagement of students. Universities should fulfil their social contract and have to meet the requirements set by the society and by their students, rather than those set by themselves.

As the experts believe that the open content will be an integral part of the teaching and learning processes within the next 15 years, the transfer and recognition, as well as microcredentialing, of OER/MOOC-based results should become an important issue. Other important issues are quality of resources and learning outcomes and assessment. Certification system should be revised and assessment procedures should be harmonized to support a wider use of open content.

The topics related to future curricula in the context of the above changes are also an object of concern for the experts, but their opinions about the necessity, scope and pace of their change vary considerably.

The experts repeatedly emphasized the need to nourish personalised learning and learner-centered approaches with due account to the change in the needs of learners and changing labour market request for skills to prepare students for a new world of work where the jobs they were taught to do may not yet exist after their graduation.

Expectations towards the future delivery and instruction mode are related to blended, project-based and interactive learning, including the use of social networks for educational purposes.

To conclude, the whole exercise was aimed at contouring and mapping the trends and desired futures for higher education with respect to the use of open content and recognition of OER/MOOC-based results. It did not attempt to predict the future, but by shaping opinions about possible futures it challenged us to consider what may lie ahead. The results of the project are meant to raise awareness of higher education stakeholders such as policy makers, managers of higher education institutions, academics, researchers and students – as well as of all readers interested in social issues.

The results of this project may also be used as a base for further surveys and discussion on the future of ICT in higher education within the following main topics:

- Prospects of the use of open content in higher education.
- Imagining business models for Education 2030 and business models that would promote the use of OER.
- Model scenarios ICT in education for different regions/challenges.
- Future development of the system of credentialing, including the trend to unbundle degrees (and content).
- Control of data (learning analytics and ethics).

References

1. Aceto, S., Borotis, S., Devine, J., and Fischer, T. (2013). Mapping and Analysing Prospective Technologies for Learning. Results from a consultation with European stakeholders and roadmaps for policy action. JRC Scientific and Policy Reports. Ed. by P. Kampylis and Y. Punie. Seville: European Commission, Joint Research Centre, IPTS. Retrieved September 1, 2016 from <http://ftp.jrc.es/EURdoc/JRC81935.pdf>.
2. Akrich, M., and Miller, R. (2006). The Future of Key Actors in the European Research Area: Synthesis Paper. Contribution to the DG Research Expert Group on The Future of Key Actors. Retrieved September 1, 2016 from http://www.eurosfair.pr.fr/7pc/doc/1188831035_thefutureofkeyactors_working_papers_en_09_web.pdf.
3. Allen, I.E., and Seaman, J. (2014). Grade Change: tracking Online Education in the United States. Retrieved September 1, 2016 from <http://www.onlinelearningsurvey.com/reports/gradechange.pdf>
4. Allen, P. (2011). The Singularity Isn't Near. MIT Technology Review. Retrieved September 1, 2016 from <https://www.technologyreview.com/s/425733/paul-allen-the-singularity-isnt-near/>.
5. Altbach, P.G., Reisberg, L., and Rumbley, L.E. (2009). Trends in Global Higher Education: Tracking an Academic Revolution. A Report Prepared for the UNESCO 2009 World Conference on Higher Education. Executive Summary. UNESCO, 2009. Retrieved September 1, 2016 from <http://unesdoc.unesco.org/images/0018/001831/183168e.pdf>.
6. Barber, M., Donnelly, K., and Rizvi, S. (2013). An avalanche is coming: Higher education and the revolution ahead. Institute for Public Policy Research, 2013. Retrieved September 1, 2016 from <http://www.avalancheiscoming.com/>.
7. Bergheim, S., Miller, R., and Tuomi, I. (2011). Learning Productivity: It is Time for a Breakthrough. Promethean Thinking Deeper Research Paper No. 2. Promethean Education Strategy Group, 2011. Retrieved September 1, 2016 from <http://www.meaningprocessing.com/personalPages/tuomi/articles/LearningProductivityFINAL.pdf>.
8. British Council (2012). The Shape of Things to Come: Higher Education Global Trends and Emerging Opportunities to 2020. Retrieved September 1, 2016 from http://www.britishcouncil.org/sites/britishcouncil.uk2/files/the_shape_of_things_to_come_-_higher_education_global_trends_and_emerging_opportunities_to_2020.pdf.
9. Butcher, N. (2011). A Basic Guide to Open Educational Resources. Retrieved September 1, 2016 from <http://unesdoc.unesco.org/images/0021/002158/215804e.pdf>.
10. Butcher, N. (2015). Technologies in Higher Education: Mapping the Terrain. Moscow, UNESCO IITE. Retrieved September 1, 2016 from <http://iite.unesco.org/publications/3214737/>.

11. Castells, M. (1996). *The Rise of the Network Society (The Information Age: Economy, Society and Culture, Volume 1)*. Massachusetts, Blackwell Publishers. Oxford, Cambridge/Massachusetts.
12. Cecchinato, M., Fleck, R., Bird, J., and Cox, A. (2015). *Online vs. Offline: Implications for Work Identity*. CHI Workshop: "Between the lines: Reevaluating the Online/Offline Binary". Retrieved September 1, 2016 from https://chibetweenthelines.files.wordpress.com/2015/02/chi2015-workshop_cecchinato.pdf.
13. Cedefop (2010). *Skills supply and demand in Europe. Medium-term forecast up to 2020*. Luxembourg: Publications Office of the European Union, 2010. Retrieved September 1, 2016 from <http://www.cedefop.europa.eu/en/publications-and-resources/publications/3052>.
14. CISCO (2010). *The Learning Society*. White Paper. Retrieved September 1, 2016 from http://www.cisco.com/c/dam/en_us/about/citizenship/socio-economic/docs/LearningSociety_WhitePaper.pdf.
15. Coiffait, L. (ed.) (2014). *Blue Skies: New thinking about the future of higher education. A collection of short articles by leading commentators*. UK 2014 Edition. London: Pearson. Retrieved September 1, 2016 from http://pearsonblueskies.com/wp-content/uploads/2012/09/4136.BlueSkies_A5_Web.pdf.
16. Deming, D. J. (2015). *Can Online Learning Bend the Higher Education Cost Curve?* USA: National Bureau of Economic Research Working Paper 20890. Retrieved September 1, 2016 from http://scholar.harvard.edu/files/lkatz/files/dgky_nber_wp_0.pdf?m=1431704360.
17. Educause (2010). *The Future of Higher Education: Beyond the Campus*. Retrieved September 1, 2016 from <https://library.educause.edu/resources/2010/1/the-future-of-higher-education-beyond-the-campus>.
18. Elahi, S., and Jeremy de Beer, J. with Kawooya, D., Oguamanam, C., Rizk, N. and the Open A.I.R. Network (2013). *Knowledge & Innovation in Africa: Scenarios for the Future*. ISBN 978-1-55250-577-9. Published by Open A.I.R, 2013. Retrieved September 1, 2016 from <http://www.openair.org.za/images/Knowledge-Innovation-Africa-Scenarios-for-Future.pdf>
19. EnGauge (2003). *21st Century Skills for 21st Century Learners: Literacy in the Digital Age*. Retrieved September 1, 2016 from <http://pict.sdsu.edu/engauge21st.pdf>.
20. Entwistle, H. (2014). *Education, Work and Leisure (Routledge Revivals)*.
21. Ernst & Young, Australia (2012). *University of the Future. A thousand year old Industry on the cusp of profound change*. Retrieved September 1, 2016 from [http://www.ey.com/Publication/vwLUAssets/University_of_the_future/\\$FILE/University_of_the_future_2012.pdf](http://www.ey.com/Publication/vwLUAssets/University_of_the_future/$FILE/University_of_the_future_2012.pdf).
22. European Commission (2009). *The World in 2025: Contributions from an Expert Group*. Ed. by Elie Faroult. DG Research, Brussels. Retrieved September 1, 2016 from http://ec.europa.eu/research/social-sciences/pdf/policy_reviews/report-the-world-in-2025_en.pdf.
23. Evans, J., and Rzhetsky, A. (2010). *Machine Science*. *Science* 329, 399.

24. Facer, K. (2009). Educational, social and technological futures: a report from the Beyond Current Horizons Programme. UK Department for Schools, Children and Family. Retrieved September 1, 2016 from <http://www2.warwick.ac.uk/fac/soc/ier/publications/2009/beyondcurrenthorizons2009.pdf>.
25. Fell, M. (2014). Roadmap for the Emerging Internet of Things – Its Impact, Architecture and Future Governance. Retrieved September 1, 2016 from http://carre-strauss.com/documents/loT_Roadmap.pdf.
26. FICCI (2014). MOOC in Indian higher education: Vision paper of the FICCI higher education Committee. New Delhi: FICCI. MOOC in Indian higher education: Vision paper of the FICCI Higher Education Committee. Retrieved September 1, 2016 from https://indiamoocs.files.wordpress.com/2014/07/ficci_visionpaper_mooc-he_v0-8.pdf.
27. FOREN (2001). A Practical Guide for Regional Foresight. FOREN Network (Foresight for Regional Development), European Commission, STRATA Programme. Retrieved September 1, 2016 from <http://foresight.jrc.ec.europa.eu/documents/eur20128en.pdf>.
28. Frey, C.B., and Osborne, M.A. (2013). The Future of Employment: How Susceptible are Jobs to Computerisation. Retrieved September 1, 2016 from http://www.oxfordmartin.ox.ac.uk/downloads/academic/The_Future_of_Employment.pdf.
29. Fullan, M., and Donnelly, K. (2013). Alive in the Swamp: Assessing Digital Innovations in Education. NESTA. Retrieved September 1, 2016 from http://www.nesta.org.uk/sites/default/files/alive_in_the_swamp.pdf.
30. Gaebel, M., Kupriyanova, V., Morais, R., and Colucci, E. (2014). E-Learning in European Higher Education Institutions: Results of a Mapping Survey. European University Association. Retrieved September 1, 2016 from <http://www.eurosvita.net/prog/data/attach/3743/e-learning-survey.pdf>.
31. Georghiou, L., Harper, J.C., Keenan, M., Miles, I., and Popper, R. (2008). Handbook of Technology Foresight. Concepts and Practice. PRIME Series on Research and Innovation Policy. Edwar Elgar Publishing, 2008.
32. GlobalHigherEd (2011, September 13). International student mobility highlights in the OECD's Education at a Glance 2011. Retrieved September 1, 2016 from <https://globalhighered.wordpress.com/2011/09/13/international-student-mobility-highlights-in-the-oecd-education-at-a-glance-2011/>.
33. Hannover Research (2011). Crosswalk of 21st Century Skills. Retrieved September 1, 2016 from <http://www.montgomeryschoolsmd.org/uploadedFiles/about/strategicplan/21stCenturySkills.pdf>.
34. HM Government (2014). The Futures Toolkit: Tools for Strategic Futures for Policy Makers and Analysts. Horizon Scanning Programme (UK). Retrieved September 1, 2016 from https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/328069/Futures_Toolkit_beta.pdf
35. Holler, J., Tsiatsis, V., Mulligan, C., Avesand, S., Karnouskos, S., and Boyle, D. (2014). From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence, 1st Edition. Elsevier Academic Press. E-book ISBN 9780080994017.

36. Huberman, M., and Minns, C. (2007). The times they are not changin': Days and hours of work in Old and New Worlds, 1870–2000. *Explorations in Economic History*, 44, pp. 538–567. Retrieved September 1, 2016 from http://personal.lse.ac.uk/minns/Huberman_Minns_EEH_2007.pdf
37. Husen, T. (1974). *The Learning Society Revisited*. Pergamon, 1986.
38. Hutchins, R.M. (1968). *The Learning Society*. Chicago: The University of Chicago Press, USA, 1968.
39. IBM (2009). *Education for a Smarter Planet: The Future of Learning*. Retrieved September 1, 2016 from <http://www.redbooks.ibm.com/redpapers/pdfs/redp4564.pdf>.
40. ILO (2015). *World Employment and Social Outlook. Trends 2015*. Retrieved September 1, 2016 from http://www.ilo.org/wcmsp5/groups/public/---dgreports/---dcomm/---publ/documents/publication/wcms_337069.pdf
41. Institute for the Future (2014). *The Future of Youth Employment: Four Scenarios Exploring the Future of Youth Employment*. Retrieved September 1, 2016 from http://www.iftf.org/fileadmin/user_upload/downloads/ourwork/IFTF_FutureYouthEmployment_December2014.pdf
42. iResearch (2014). *2014 China Online Education Report (Brief Edition)*. Retrieved September 1, 2016 from http://www.iresearchchina.com/content/details8_19472.html.
43. Jarvis, P. (2006). Beyond the learning society: globalisation and the moral imperative for reflective social change. *International Journal of Lifelong Education*. Volume 25, Issue 3, 2006. Pp. 201-211.
44. Johnson, L., Adams Becker, S., Cummins, M., Estrada, V., Freeman, A., and Hall, C. (2016). *NMC Horizon Report: 2016 Higher Education Edition*. Austin, Texas: The New Media Consortium. Retrieved September 1, 2016 from <http://cdn.nmc.org/media/2016-nmc-horizon-report-he-EN.pdf>.
45. Johnson, L., Adams Becker, S., Estrada, V., and Freeman, A. (2015). *NMC Horizon Report: 2015 Higher Education Edition*. Austin, Texas: The New Media Consortium. Retrieved September 1, 2016 from <http://cdn.nmc.org/media/2015-nmc-horizon-report-HE-EN.pdf>.
46. Kampylis, P., Punie, Y., and Devine, J. (2015); *Promoting Effective Digital-Age Learning – A European Framework for Digitally-Competent Educational Organisations*. EUR 27599 EN; doi:10.2791/54070. Retrieved September 1, 2016 from http://publications.jrc.ec.europa.eu/repository/bitstream/JRC98209/jrc98209_r_digcomporg_final.pdf.
47. Kranenburg, R. van, and Dobson, S. (2008). *The Internet of Things: A Critique of Ambient Technology and the All-Seeing Network of RFID*. Institute of Network Cultures, 2008. Retrieved September 1, 2016 from http://www.networkcultures.org/_uploads/notebook2_theinternetofthings.pdf.
48. Kurzweil, R. (2005). *The Singularity is Near: When Humans Transcend Biology*. Viking Press; ISBN 0670033847.

50. Lawton, W., Ahmed, M., Angulo, T., Axel-Berg, A., Burrows, A., and Katsomitros, A. (2013). *Horizon Scanning 2013: What Will Higher Education Look Like in 2020?* Retrieved September 1, 2016 from <https://www.lfhe.ac.uk/en/research-resources/publications-hub/index.cfm/OT-Ext-02>.
51. Levin, D., and Arafeh, S. (2002). *The Digital Disconnect: The Widening Gap between Internet-Savvy Students and Their Schools*. Washington DC, USA: Pew Internet & American Life Project. Retrieved September 1, 2016 from <http://epsl.asu.edu/epru/articles/EPRU-0208-36-OWI.pdf>.
52. Luksha, P., and Peskov, D. (2014) *Future Agendas for Global Education*. Executive Summary. Retrieved September 1, 2016 from http://edu2035.org/pdf/GEF_Agenda_eng.pdf.
53. Machlup, F. (1962). *The Production and Distribution of Knowledge in the United States*. Princeton: Princeton University Press.
54. Mansell, R. (2012). ICT, discourse and knowledge societies: implications for policy and practice. In: Frau-Meigs, D., Nicey, J., Palmer, M., Pohle, J., and Tupper, P. (eds.). *From Nwico to WSIS: 30 Years of Communication Geopolitics: Actors and Flows, Structures and Divides*. ECREA series. Intellect, Bristol. ISBN 9781841505862.
55. Mazmanian, M., and Erickson, I. (2014). The product of availability: understanding the economic underpinnings of constant connectivity. In: *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems Pages*. New York: ACM. Pp. 763-772.
56. Mansell, R., and Tremblay, G. (2013). *Renewing the Knowledge Societies Vision for Peace and Sustainable Development*. Report prepared for the WSIS+10 Review Event “Towards Knowledge Societies for Peace and Sustainable Development”. Paris, 25-27 February 2013. Retrieved September 1, 2016 from <http://unesdoc.unesco.org/images/0022/002245/224531E.pdf>.
57. Miller, R. (2003). *The Future of the Tertiary Education Sector: Scenarios for a Learning Society*. Prepared for the OECD/Japanese Seminar on the Future of Universities, Tokyo, 11-12 December, 2003. OECD-CERI. Retrieved September 1, 2016 from http://www.mext.go.jp/a_menu/kokusai/forum/04022701/004/001.pdf.
58. Miller, R., Looney, J., and Wynn, J. (2010). *Thinking Strategically about Education and Technology: Making Learning Happen Today for Tomorrow’s World*. Thinking Deeper Research Paper No.1 – Parts 1 & 2. Promethean Education Strategy Group, 2010. Retrieved September 1, 2016 from <http://innovationunit.org/sites/default/files/Promethean%20-%20Thinking%20Deeper%20Research%20Paper%20parts%201%20and%202.pdf>.
59. Miller, R., Shapiro, H., and Hilding-Hamann, K.E. (2008). *School’s Over: Learning Spaces in Europe in 2020: An Imagining Exercise on the Future of Learning*. Seville: IPTS, 2008. Retrieved September 1, 2016 from <http://ftp.jrc.es/EURdoc/JRC47412.pdf>.
60. Noorden, R. van (2014). Global scientific output doubles every nine years. *Nature News Blog*, 07 2014. Retrieved September 1, 2016 from <http://blogs.nature.com/news/2014/05/global-scientific-output-doubles-every-nine-years.html>.

61. NRC (2012). Research Universities and the Future of America: Ten Breakthrough Actions Vital to Our Nation's Prosperity and Security. National Research Council of the National Academies Washington, the National Academies Press, 2012. Retrieved September 1, 2016 from http://sites.nationalacademies.org/cs/groups/pgasite/documents/webpage/pga_070193.pdf.
62. Nunes, A.A., Delicado, A., de Almeida Alves, N., and Carvalho. T. (2014). Internet, children and space: Revisiting generational attributes and boundaries, *New Media & Society*, pp. 1–18. ISSN 1461-7315; DOI: 10.1177/1461444814528293.
63. OECD (1996). The Knowledge-Based Economy. OECD Publishing. Retrieved September 1, 2016 from <https://www.oecd.org/sti/sci-tech/1913021.pdf>.
64. OECD (2013). Trends Shaping Education 2013. OECD Publishing. Retrieved September 1, 2016 from http://www.oecd-ilibrary.org/education/trends-shaping-education-2013_trends_edu-2013-en.
65. OECD (2014). Education at a Glance 2014: OECD Indicators. OECD Publishing. Retrieved September 1, 2016 from <http://www.oecd.org/edu/Education-at-a-Glance-2014.pdf>.
66. OECD (2014). OECD Factbook. Economic, Environmental and Social Statistics. Retrieved September 1, 2016 from <http://www.oecd.org/publications/oecd-factbook-18147364.htm>.
67. Osborne, J., and Hennessy, S. (2003). Report 6: Literature Review in Science Education and the Role of ICT: Promise, Problems and Future Directions. FUTURELAB Series. Retrieved September 1, 2016 from <https://www.nfer.ac.uk/publications/FUTL74/FUTL74.pdf>.
68. Partnership for 21st Century Skills (2008). Framework for the 21st Century Learning. Retrieved September 1, 2016 from http://www.p21.org/storage/documents/1.__p21_framework_2-pager.pdf.
69. Perez, C. (2003). Technological Revolutions and Financial Capital: The Dynamics of Bubbles and Golden Ages. Cheltenham, UK: Edward Elgar. ISBN-10: 1843763311.
70. Piketty, T. (2014). Capital in the Twenty-First Century. Massachusetts: The Belknap Press of Harvard University Press, 2014.
71. Popescu, A.I. (2011). The learning society as a key for development. In: Proceedings of the 7th Administration and Public Management International Conference. Retrieved September 1, 2016 from https://papers.ssrn.com/sol3/papers.cfm?abstract_id=1934428.
72. Prensky, M. (2001, October). Digital Natives, Digital Immigrants. On the Horizon (MCB University Press, Vol. 9 No. 5). Retrieved September 1, 2016 from <http://www.marcprensky.com/writing/Prensky%20-%20Digital%20Natives,%20Digital%20Immigrants%20-%20Part1.pdf>.
73. Prensky, M. (2014, May). The world needs a new curriculum. Retrieved September 1, 2016 from http://marcprensky.com/wp-content/uploads/2013/05/Prensky-5-The-World_Needs_a_New_Curriculum.pdf.

74. Punie, Y., and Cabrero, M. (2006). The Future of ICT and Learning in the Knowledge Society. Report on a Joint DG JRC/IPTS-DG EAC Workshop held in Sevilla, 20-21 October 2005, DG JRC-IPTS, European Communities, March 2006, EUR 22218 EN. Retrieved September 1, 2016 from
75. Punie, Y., and Ala-Mutka, K. (2007). Future Learning Spaces: new ways of learning and new digital skills to learn. *Digital Kompetanse*, 2007, Vol. 2, Issue 4, pp. 210–225. Retrieved September 1, 2016 from http://is.jrc.ec.europa.eu/pages/EAP/documents/2007Learning_SpacesDigitalLiteracy.pdf.
76. Rathenau Institute (2014). Future Knowledge: 4 scenarios for the Future of Dutch Universities. The Hague. Retrieved September 1, 2016 from http://www.vsnu.nl/files/documenten/Domeinen/Strategie-PA/Toekomststrategie/Future_Knowledge_scenario_study.pdf.
77. Redecker, C., Leis, V., Leendertse, M., Punie, Y., Gijsbers, G., Kirschner, P., Stoyanov, S., and Hoogveld, B. (2011). The Future of Learning: Preparing for Change. Seville: IPTS, 2011. Retrieved September 1, 2016 from <http://ftp.jrc.es/EURdoc/JRC66836.pdf>.
78. ReFuture.me (2014). Re-Engineering Futures: Future Agendas for Global Education. Retrieved September 1, 2016 from <http://refuture.me/>.
79. Rij, V. van (2013). New emerging issues and wild cards as future shakers and shapers. In: Recent Developments in Foresight Methodologies. Giaoutzi, M. and Sapio, B. (eds.). Springer. ISBN 978-1-4614-5214-0 (print), 978-1-4614-5215-7 (online).
80. Rij, V. van (2015-1). 21st Century Higher Education: Quick Scan of Foresight and Forward Looks on Higher Education in the ICT Age. Retrieved September 1, 2016 from http://www.iite.unesco.org/files/news/639201/Foresight_on_HE_and_ICT_Discussion_paper.pdf.
81. Rij, V. van (2015-2). Trends of 21st Century Higher Education: Quick Scan of Foresight and Forward Looks on Higher Education in the ICT Age. Retrieved September 1, 2016 from http://www.iite.unesco.org/files/news/639201/Annex_to_Discussion_Paper_Foresight_on_HE_and_ICT.pdf.
82. Ruth, S. R. (2012). Can ICT do more to reduce higher Ed costs? *International Journal of Technology in Teaching and Learning*, 6(2), 103--115.
83. Schumpeter, J.A. (1950). Capitalism, Socialism, and Democracy. 3rd ed. 1942. New York: Harper and Brothers, 1950.
84. Soete, L. (2005). Innovation, technology and productivity: Why Europe lags behind the United States and why various European economies differ in innovation and productivity. In: Castells, M. and Cardoso, G. (eds.). The Network Society: From Knowledge to Policy. Washington, DC: Johns Hopkins Center for Transatlantic Relations, 2005. Retrieved September 1, 2016 from http://www.umass.edu/digitalcenter/research/pdfs/JF_NetworkSociety.pdf.
85. Soete, L. (2006). A Knowledge Economy Paradigm and Its Consequence. UNU – MESRTCIT Working Paper Series, No. 001. Maastricht: Maastricht Economic and Social Research and Training Centre on Innovation and Technology. Retrieved

September 1, 2016 from <http://www.merit.unu.edu/publications/working-papers/abstract/?id=2511>.

86. The Economist (2014-1). The future of jobs, the onrushing wave. The Economist, January 18, 2014. Retrieved September 1, 2016 from <http://www.economist.com/news/briefing/21594264-previous-technological-innovation-has-always-delivered-more-long-run-employment-not-less>.
87. The Economist (2014-2). The future of universities. The digital degree. The staid higher-education business is about to experience a welcome earthquake. The Economist, June 28, 2014. Retrieved September 1, 2016 from <http://www.economist.com/news/briefing/21605899-staid-higher-education-business-about-experience-welcome-earthquake-digital>.
88. Thornburg, D. (1997). 2020 Visions for the Future of Education. Retrieved September 1, 2016 from <http://tcpd.org/Thornburg/Handouts/2020visions.html>.
89. Uhlsa, Y.T., Michikyan, M., Morris, J., Garcia, D., Small, G.W., and Zgourou, E. (2014). Five days at outdoor education camp without screens improves preteen skills with nonverbal emotion cues. In: Computers in Human Behavior. Elsevier, 2014. Vol. 39. Retrieved September 1, 2016 from
90. UIL (2012). Second Global Report on Adult Learning and Education: Rethinking Literacy. Retrieved September 1, 2016 from <http://unesdoc.unesco.org/images/0022/002224/222407e.pdf>.
91. UK Commission for Work and Skills (2014). The Future of Work, Jobs and Skills in 2030. Evidence Report 84. Retrieved September 1, 2016 from https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/303334/er84-the-future-of-work-evidence-report.pdf.
92. UNDP (2014). Human Development Report 2014, Sustaining Human progress, reducing vulnerability and building resilience. Washington DC – USA. Retrieved September 1, 2016 from <http://hdr.undp.org/sites/default/files/hdr14-report-en-1.pdf>.
93. UNESCO (2005). Towards Knowledge Societies. Paris: UNESCO, 2005. Retrieved September 1, 2016 from <http://unesdoc.unesco.org/images/0014/001418/141843e.pdf>.
94. UNESCO (2012). EFA Global Monitoring Report. Youth and skills: Putting education to work. Retrieved September 1, 2016 from <http://unesdoc.unesco.org/images/0021/002180/218003e.pdf>.
95. UNESCO (2013). Towards Knowledge Societies for Peace and Sustainable Development: First WSIS+10 Review Event. Paris: UNESCO. Retrieved September 1, 2016 from http://www.unesco.org/new/fileadmin/MULTIMEDIA/HQ/CI/CI/pdf/wsisis/WSIS_10_Event/wsisis10_outcomes_en.pdf.
96. UNESCO (2014). Shaping the Future We Want. UN decade of Education for Sustainable Development. Retrieved September 1, 2016 from <http://unesdoc.unesco.org/images/0023/002301/230171e.pdf>.
97. UNESCO (2015-1). Rethinking Education: Towards a Global Common Good. Retrieved September 1, 2016 from <http://unesdoc.unesco.org/images/0023/002325/232555e.pdf>.

98. UNESCO (2015-2). Position Paper on Education Post-2015. Retrieved September 1, 2016 from <http://unesdoc.unesco.org/images/0022/002273/227336E.pdf>.
99. UNESCO IITE (2013). Introduction to MOOC: Avalanche, Illusion or Augmentation? Moscow, UNESCO IITE. Author: Grainger, B. Retrieved September 1, 2016 from <http://iite.unesco.org/pics/publications/en/files/3214722.pdf>.
100. UNIDO (2005). UNIDO Technology Foresight Manual. Vol. 1-2. Retrieved September 1, 2016 from http://www.research.ro/img/files_up/1226911327TechFor_1_unido.pdf and http://ictt.by/En/Docs/UNIDOTechForesight/Vol.II_E-book.pdf.
101. UNITE (2014) Living and Learning in 2034. A higher education futures project. University Alliance and UNITE. Retrieved September 1, 2016 from http://www.unite-group.co.uk/binaries/868/792/living-learning-in-2034_final,0.pdf.
102. United Nations (2014). Probabilistic Population Projections based on the World Population Prospects: The 2012 Revision. Population Division, DESA. ST/ESA/SER.A/353. Retrieved September 1, 2016 from <https://esa.un.org/unpd/wpp/>.
103. Van Rij, V., and Warrington, B. (2011). Teaching and Learning for an ICT revolutionized society, EC – FAR Horizon project. Manchester: University of Manchester, 2011. Retrieved September 1, 2016 from [https://farhorizon.portals.mbs.ac.uk/Portals/73/docs/Farhorizon TL for ICT.pdf](https://farhorizon.portals.mbs.ac.uk/Portals/73/docs/Farhorizon%20TL%20for%20ICT.pdf)
104. Waldrop, M.M. (2013). Online learning: Campus 2.0. Massive open online courses are transforming higher education – and providing fodder for scientific research. *Nature*, 13 March 2013. Retrieved September 1, 2016 from <http://www.nature.com/news/online-learning-campus-2-0-1.12590>.
105. Wang, W.-C. (2011). Transformations of employment and occupation patterns in Taiwan’s transition to an information society. *Chinese Journal of Communication*. Vol. 4, Issue 4, 2011. Retrieved September 1, 2016 from <http://www.tandfonline.com/doi/pdf/10.1080/17544750.2011.616291>.
106. Wheeler, S. (2015). Learning with ‘e’s: Educational Theory and Practice in the Digital Age. ISBN 978-1- 84590-939-0.
107. Wilson, R. (2009). The future of work and implications for education. In: *Beyond Current Horizons*. Warwick, 2009.
108. Witthaus, G., Inamorato dos Santos, A., Childs, M., Tannhäuser, A., Conole, G., Nkuyubwatsi, B., and Punie, Y. (2016). Validation of Non-formal MOOC-based Learning: An Analysis of Assessment and Recognition Practices in Europe (OpenCred). Retrieved September 1, 2016 from <http://publications.jrc.ec.europa.eu/repository/bitstream/JRC96968/lfna27660enn.pdf>.

Annex 1: Questionnaire

The survey organized within the project “Access, Equity and Quality: Envisioning the Sustainable Future of Postsecondary Education in a Digital Age” run by the UNESCO Institute for Information Technologies in Education is aimed to identify how the technological change in relation to the development of the social and economic context is changing the learning needs and opportunities as well as the organizational and institutional settings of postsecondary education and what are the key implications for policy makers in governments, universities, companies and civil society. The main topics of the survey are:

- Future curricula and learning context
- Future learning credentials and validation
- Future role of faculty and teachers
- Changing role of HE institutions
- Business models

The questionnaire was tested and discussed with the UNESCO Chairs in ICT in Education and during the Global High-Level Policy Forum. We kindly invite you to contribute to our project by answering the questions of the survey, which is open online from June to October 2015.

General information about the respondent

Please answer several questions to specify your background.

1. What country do you come from?
2. What is the name of the organization that employs you?
3. What is your function?
 - Board Member/Advisor on the national level
 - Board Member/Advisor of the institution
 - Board Member/(Vice) Dean/Advisor of a faculty
 - Researcher
 - Professor/Teacher
 - Other
4. What is your disciplinary background or the discipline of your current/most recent academic appointment or affiliation?
 - Natural sciences
 - Mathematics
 - Information Science
 - Technology
 - Medicine
 - Social Sciences

- Economics
 - Humanities
 - Arts
 - Other, please, specify
5. What kind of organization are you working for?
- Higher education institution
 - Other, if so what kind of organization?
6. If you are working for an educational institution, how much of the staff (time) is spent for research?
- More than 50% for research
 - 20-50% for research
 - Less than 20% for research
 - No research
7. How many students are registered at your (main) institute?
- Less than 5000
 - 5000 – 20 000
 - 20 000 – 50 000
 - More than 50 000
8. Which disciplines does your (main) institute cover?
- All
 - All except for
 - Only a limited set

Section 1: Validation and credentialing of learning results and open educational resources

The internet offers an overwhelming amount of open educational resources and open digital courseware (OCW, MOOC and WIKIs) that cross national borders and may increasingly offer alternatives to the present curricula-based focus of higher education. The IITE expert meeting concluded that this development may force institutions to rethink the system of awarding credits and even revise the concept of locally-bound curricular learning.

1.1. Do you agree that ICT-induced changes force higher education institutions to rethink the system of awarding credits and validation of learning results?

- No
- To a small extent
- To some extent
- To a great extent
- Fully

1.2. Please explain your answer

Crucial questions are arising about the need for formal degrees and qualifications when knowledge and learning are abundantly available. Other related questions include the way in which institutions will accept formal and informal learning credentials (such as degree attainment or course completion) from elsewhere and the increasing

need for lifelong learning, rather than a single point-in-time, immersive educational experience. These issues raise the possibility of a fragmentation (or unbundling) of learning activities and credentials, particularly when lifelong learning dimension is concerned.

1.3. Do you expect that the future labour market will still require formal higher education degrees 15 years from now?

- Completely not
- Far less than now
- Less than now
- The same as now
- More than now

1.4. Comment

1.5. Do you think that higher education institutions will incorporate the contents (Open Educational Resources and/or (Massive) Open Online Courses) produced by other institutions?

- No
- To a small extent
- To some extent
- To a great extent
- Fully

1.6. Comment

1.7. Do you think that higher education institutions will accept credits awarded via Open Educational Resources and/or (Massive) Open Online Courses produced by other institutions?

- No
- To a small extent
- To some extent
- To a great extent
- Fully

1.8. Under what conditions would your HEI/university recognize credits from Open Educational Resources and/or (Massive) Open Online Courses produced by other institutions (please consider the opportunities for formal accreditation, cooperation, etc.)

- If the other institutions are accredited/recognized within a reliable national accreditation system
- If the other institutions are accredited/recognized by a reliable international (disciplinary) authority
- If my institute has an exchange agreement with the other institutions
- Other, please, specify

1.9. Do you think that Open Educational Resources and/or (Massive) Open Online Courses may lead to fragmentation of accreditation and validation of higher education degrees?

- No
- To a small extent
- To some extent
- To a great extent
- Fully

1.10 Comments

Section 2: Questions to Board Members/policy advisors of higher education institutions

If you are Board member or policy advisor of a higher education institution or faculty (or fulfil similar functions) please answer this section. If not, please go to the next section

2.1. Is your institution planning to contribute or already engaged in development of open educational sources for undergraduate students?

- Never
- Not now
- We discuss this
- We have plans
- We are already involved

2.2. Is your HEI/university planning to contribute or already engaged in development of open educational resources for postgraduate students?

- Never
- Not now
- We discuss this
- We have plans
- We are already involved

2.3. If so, what percentage of all your institutions undergraduate credits are awarded annually with the use of open educational resources produced by your institution?

- 0%
- 0-25%
- 50-75%
- 75-100%

2.4. What percentage of all of your institutions undergraduate credits is awarded annually using open educational resources produced by other institutions?

- 0%
- 0-25%
- 50-75%
- 75-100%

2.5. Will your institution/faculty integrate (accept) open educational resources from elsewhere?

- Never
- Not now
- Yes, if the quality is ok
- Yes but only under certain conditions
- Unconditionally

2.6. If you replied “under certain conditions”, please specify the conditions?

- Only from partner with whom we cooperate
- Only when the examination takes place at our HEI/university
- Other

2.7. Are you aware of the enormous amount of other open online resources that people use for self-learning (for HE level as well)?

- No
- To a small extent
- To some extent
- To a great extent
- Fully

2.8. Does your HEI/university consider validating the “self-learning” results as mentioned above (as part of your curriculum)?

- Never
- Not now
- Perhaps
- Likely
- Yes

2.9. If you replied “perhaps” or “yes” how would you consider validating and accrediting these?

- Not at all
- As exemption if a student asks for examination
- As part of the curriculum
- Otherwise

ICT offers many opportunities to provide access to education for people with disabilities. Some of these opportunities require little or no additional investments, like distance learning for people with mobility problems. Other solutions, like oral provisions for blind people and additional visual support for people with hearing impairments may require additional investments.

2.10. Do you expect your HEI/university to ensure these special provisions for people with disabilities within its mission?

- No

- To a small extent
- To some extent
- To a great extent
- Fully

Section 3: Curriculum change /Institutional development and teachers

3.1. Future curricula and the expanding formal learning opportunities

Open digital resources and courseware can be used in many locations around the world, while ICT opens up the possibilities for international cooperation of learners through the internet. These developments create the opportunity for institutions and faculty to offer a larger variety of new learning experiences at low cost to their students.

3.1.1. Do you think that curriculum reform is required due to the development of digital open courseware and resources?

- No
- To a small extent
- To some extent
- To a great extent
- Fully

3.1.2. Comments

3.1.3. Do you think that special measures are needed for (re)training teaching and supporting staff for the use of digital open courseware and resources?

- No
- To a small extent
- To some extent
- To a great extent
- Fully

3.1.4. Comments

3.1.5. Do you believe that online learning will account for a growing share of all learning in higher education?

- No
- To a small extent
- To some extent
- To a great extent
- Fully

3.1.6. Comments

3.2. Fast changing contents

Technology (in particular ICT and other technologies) changes our society and economy. The amount of available data is increasing enormously along with technologies to process and apply the data. Thus, it is increasingly possible to exchange thoughts, ideas, information and knowledge across the world and to build networks and shared expertise systems that far exceed individual capacities. For example, some experts

expect systems like “google translate” to surpass the capabilities of professional translators within the coming decades. Such developments suggest that curricula in higher education have to change much faster than ever before.

3.2.1. Do you agree with the idea that the fast developing technologies will urge faster change of the contents of curricula?

- No
- To a small extent
- To some extent
- To a great extent
- Fully

3.2.2. Comments

3.2.3. If you agree, do you think that these developments urge curriculum reform?

- No reform
- Some reform
- Considerable reform
- A very considerable reform
- Total reform

3.2.4. What kind of curriculum reform is needed regarding the objectives, learning methods, and contents?

3.3. Learning to use expanding technological possibilities

Curricula in higher education are focused on the use of advanced technologies that are changing at an accelerating pace. These technologies tend to take over more and more work that requires high-level cognitive skills that are taught to students. Some experts stress therefore the necessity to learn using these expanding technological possibilities and to foresee their future development and potential rather than focusing on skills that will be obsolete within a foreseeable time scale.

3.3.1. Do you agree with the idea that the “learning to learn using and knowing the expanding technological possibilities” is one of the key objectives of higher education?

- No not at all
- To a small extent
- To a reasonable extent
- To a great extent
- Fully

3.3.2. Comments

3.3.3. If you agree, do you think that these developments urge curriculum reform?

- No reform
- Some reform
- Considerable reform
- A very considerable reform

- Total reform

3.3.4. What kind of curriculum reform do you have in mind thinking about objectives, learning methods, and contents?

3.4. Changing role of higher education institutions

3.4.1. Does the reform under (3.1, 3.2 and or 3.3) have an impact on the role of institutions and teachers?

- None
- Some impact
- Large impact
- Complete change of roles

3.4.2. If so, how will the role and skills needed for future teachers change?

3.4.3. How will the role of faculty and educational teams, etc. change?

3.4.4. Can you describe your vision on how the role will change and which special provisions are needed?

3.5. Future role of institutions and faculty

Due to the fact that ICT is changing the society and economy, as well as the way the (new) knowledge is created and learned, the experts foresee that institutions will have to reflect on their role in the societal and economic ecosystem changed by ICT. Possible different roles might include basic knowledge creation (incorporating new ways of knowledge creation), elite education, translation and creation of knowledge for regional development, and mass education. Another possibility is that institutions will specialize in either open distance education or campus-based learning.

3.5.1. How do you see the further development and role of open distance learning institutions (ODL) and that of regional and/or campus-based universities and higher education institutions (CBL) in your country?

- Both will specialize more and more
- They will both stay developing in their own role
- Both will take over each others functions
- They will merge more and more
- They will completely merge

3.5.2. Which statement is true for your country?

- ODL will grow faster than CBL
- ODL and CBL will grow at the same pace
- CBL will grow faster than ODL

3.5.3. What are the main reasons for this?

3.5.4. Do you agree with the idea that higher education institutions will have to reflect on their role in the fast developing ICT-driven society and economy?

- Not at all
- To a small extent
- To a reasonable extent

- To a great extent
- Fully

3.5.5. If you agree please explain what kind of role changes for institutions you expect in general?

3.5.6. What kind of role changes you expect for you own institution (if applicable)?

3.6. Business models / access and quality

ICT provides the possibility to offer education over large distances and even throughout the world in different language areas. Some developers offer courses (MOOC) for free or reduced prices to an enormous audience (but often with very low completion rates)? In the meantime there is an enormous difference in the prices that students have to pay for education around the world.

3.6.1. Do you expect the average inflation-corrected costs for the production of higher education learning materials in your country to?

- Rise enormously
- Rise somewhat
- Stay the same
- Diminish somewhat
- Diminish substantially

3.6.2. Do you expect the average inflation-corrected demand price for higher education in your country?

- Rise enormously
- Rise somewhat
- Stay the same
- Diminish somewhat
- Diminish substantially

3.6.3. How do you expect the quality of higher education to change in your country?

- Rise enormously
- Rise somewhat
- Stay the same
- Diminish somewhat
- Diminish substantially

ICT for education of people with disabilities sometimes require additional investments, for instance, oral provisions for people with visual impairments and additional visual support for deaf.

3.6.4. Who do you think should pay for this?

- The HE institutes themselves
- Governments
- Charity funds
- The clients themselves

Annex 2: Geographical Distribution of Respondents

Afghanistan	1
Australia	19
Austria	1
Azerbaijan	4
Bangladesh	1
Belarus	1
Botswana	1
Brazil	5
Bulgaria	2
Cameroon	1
Canada	1
China	3
Cuba	1
Cyprus	1
Czech Republic	1
Ethiopia	1
Fiji	5
Finland	1
France	7
Germany	3
Greece	1
Hungary	2
India	3
Indonesia	1
Iran (Islamic Republic of)	1
Ireland	2
Israel	4
Italy	3
Kuwait	1
Lithuania	1
Malaysia	2
Mali	1
Mongolia	1
Netherlands	11
New Zealand	4
Nigeria	1
Norway	1
Pakistan	1
Republic of Korea	1
Republic of Moldova	1
Russian Federation	5
Saudi Arabia	1
Slovenia	1
South Africa	10
Spain	6
Sri Lanka	1
Tajikistan	1
Trinidad and Tobago	1
Turkey	2
United Kingdom of Great Britain and Northern Ireland	4
United States of America	10
Uzbekistan	1
Zimbabwe	1

How will higher education evolve over the next 15 years? How might technological changes impact the society, labour market, higher education systems and institutions? What opportunities and challenges do they imply? How can and do countries and institutions address these changes? How should higher education institutions adapt to the changing learning needs? What impact will the availability of new technologies and online resources have on how and where people learn? Are national systems of recognition of learning outcomes and credentialing prepared to accommodate the results of open education? Will the system of higher education develop towards open online learning or campus-based learning?

These and other questions were raised within the UNESCO IITE project “Access, Equity and Quality: Envisioning the Sustainable Future of Postsecondary Education in a Digital Age” to derive the key implications for decision and policy makers at national and institutional levels. The project was focused on the issues of future learning contexts for open content, future curricula, futures of learning credentials and validation, the future role of teachers and faculty, and changing role of higher education institutions.

This publication is an invitation to debate the issues raised and discussed not just about the future that we expect for the higher education and ICT, but also the future we chose to create.

