Educational Technology as a Key to Unlocking the Fourth Industrial Revolution - Malaysian Higher Learning Perspectives

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About Universiti Teknologi Malaysia (UTM)
Industrial Revolution 4.0
Malaysia Higher Education 4.0 (MyHE 4.0)
UTM 4.0 Initiatives (Digital Nervous System)
Conclusions and future outlook

International Conference on University 4.0, Nguyen Tat Thanh University, Ho chi Minh, Vietnam on July 20-21, 2017 (http://university40.ntt.edu.vn/)
From Industry 1.0 to Industry 4.0

Source: DFKI

World Economic Forum Annual Meeting 2016, Davos-Klosters, Switzerland.
Theme: “Mastering the Fourth Industrial Revolution”
20-23 January 2016

Professor Klaus Schwab, Founder and Executive Chairman of the World Economic Forum

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4IR (Fourth Industrial Revolution)

The Fourth Industrial Revolution

What It Means and How to Respond

By Klaus Schwab

We stand on the brink of a technological revolution that will fundamentally alter the way we live, work, and relate to one another. In its scale, scope, and complexity, the transformation will be unlike anything humankind has experienced before. We do not yet know just how it will unfold, but one thing is clear: the response to it must be integrated and comprehensive, involving all stakeholders of the global polity, from the public and private sectors to academia and civil society.
What does 4IR mean?

• “We stand on the brink of a technological revolution that will fundamentally alter the way we live, work, and relate to one another. In its scale, scope, and complexity, the transformation will be unlike anything humankind has experienced before. We do not yet know just how it will unfold, but one thing is clear: the response to it must be integrated and comprehensive, involving all stakeholders of the global polity, from the public and private sectors to academia and civil society.”

Professor Klaus Schwab,
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• **Velocity**: Contrary to the previous industrial revolutions, this one is evolving at an exponential rather than linear pace. This is the result of the multifaceted, deeply interconnected world we live in and the fact that new technology begets newer and ever more capable technology.

• **Breadth and depth**: It builds on the digital revolution and combines multiple technologies that are leading to unprecedented paradigm shifts in the economy, business, society, and individually. It is not only changing the “what” and the “how” of doing things but also “who” we are.

• **Systems Impact**: It involves the transformation of entire systems, across (and within) countries, companies, industries and society as a whole.
The University of the Future

Challenges of future teaching and learning must be turned into opportunities for change:

Change of organisational structures
- Change of business models
- Cooperative efforts enhancing interdisciplinarity
- New concept for faculties or departments

Change of accreditation procedures
- New role of examination offices
- No fixed degree programmes
- Acceleration of education according to fast innovation cycles

Change of teaching methods
- New teaching concepts (e.g., flipped classroom)
- New teaching infrastructures (e.g., equipment for virtual worlds)
- Digital rights management

Change of learning
- Active vs. Personalized learning
- New learning infrastructures (e.g., increased computing capacities)
- Shift from presence learning to distance learning

Digital culture
- Digital technologies pervade and connect all aspects of daily life
- Development of various digital lifestyles
- New mental models, e.g., knowledge no longer dominated by group distances
- New forms of social communication, participation and organization
- Leading to globalization of education
- New learning/process solving styles
- NLP, Web 4.0 on its way
- Semantics makes „search“ more efficient
- Goups on-demand philosophy spreading
- Merging all types of information, semantic integration

Individualization
- Individualization – a global phenomenon
- Few strong, many weak relationships
- Complex biographies and identities
- Personalization and individualization in learning and education „ chanting“
- Social cohesion shifted from physical to virtual world
- Distances in mind sets become even more visible
- Individual education for the masses
- Self-paced learning
- Individual modular degrees

Industry 4.0 Framework (PwC, 2016)

Source: Sabina Jeschke, Engineering Education for Industry 4.0, 2016

Source: PwC, 2016
Industry 4.0 Technologies, IT/OT Applications and & Engineering Transformations

Table 5. Potential Industry 4.0 applications for engineering transformation

<table>
<thead>
<tr>
<th>Engineering impact</th>
<th>Potential IT/OT applications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reduce idea-to-market time</td>
<td>Use rapid prototyping and production capabilities to design new products and online supplier chain dependencies, configure new software solutions through cloud-enabled development tools</td>
</tr>
<tr>
<td>Better link design to product intelligence</td>
<td>Use data to anticipate design flaws and correct for them; design products and simulate usage based on total cost of ownership and supply implications; evaluate product design options based on manufacturability</td>
</tr>
<tr>
<td>Improve the overall effectiveness of engineering*</td>
<td>Design and test new products through virtual simulation software; allow open source sharing of intellectual property to spur or improve designs</td>
</tr>
</tbody>
</table>

Source: Deloitte analysis.

Disruptive Science and Technology Innovations

TANGIBLE AND INTANGIBLE

Self Driving Car

Tesla

3D Printing

SpaceX Reusable Rocket

Boston Dynamics Robots
Disruptive Science and Technology Innovations

Virtual and Augmented Reality

Drone

Microsoft Holoportation

Real-time Face2Face Reenactment of Video

Google AlphaGo

PRIMARILY STEM SKEWED

Repetitive jobs that can be automated will be replaced
Malaysia Higher Education 4.0 (MyHE 4.0)

Malaysian Higher Education Landscape

Source: Ministry of Higher Education, Malaysia (2017b)
Developments of Malaysian Higher Education

Source: Abdullah, D. (2017)

Accelerating PACE of CHANGE due to DIGITAL age
GLOBAL Competition due to GLOBALIZATION
Economic crisis
GLOBAL Economic crisis

Addressing Current and Future Challenge

- Graduates for Economic vs Society Needs
- Responsible Citizen viz Global citizen
- Graduates 21st Century Skills
- Information Overloads
- Institutional Autonomy vs Accountability
- R&D Input vs Outputs

Challenges facing higher education

- Institutional Reputation
- Industry-Academia Collaboration
- Financial Sustainability
- Return on Investment
- Equitable Access
Challenges in Transformation for HE

- **NEW academia**
- **Diverse purposes of HE**
- **Mediating competing goals**
- **Adequacy of state funding**
- **Social and political value**
- **Intellectual spaces**

**Access:** Social Equity vs Quality

- Incorporation of Wider Social Purpose: Economic and Well Being

- Democratic Citizenship and Cultivation of Humanity

- Commitment: “To The Spirit of Truth”

- New Generation of Academics

- Institutional Autonomy and Accountability

**Souls of HE**

**Malaysian Education Blueprint (MEB) 2015-2025 (Higher Education)**

**SYSTEM ASPIRATIONS**

Launched in April 2015
1. **SELF-GOVERNING INSTITUTIONS** - autonomous, both UA/US (high) Compoundable
2. **SELF-ACCREDITATION**
3. **WAQAF CONTRIBUTION AND UNIV REVENUE** = 30 to 50 ?%
4. **OPEN ACADEMIC TENURESHIP** (Freelance)
5. **SHARED GOVERNANCE** - students in Senate, Board, students host convos
6. Lean MOHE/MQA

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**The MEB (HE) Sets Out Clear System and Student Aspirations**

**System Aspirations**
- Access
- Quality
- Equity
- Unity
- Efficiency

**Student Aspirations**
- Ethics & Spirituality
- Leadership Skills
- National Identity
- Language Proficiency
- Thinking Skills
- Knowledge

AKHLAK (Ethics and Morality) | BALANCE | ILMU (Knowledge and Skills)
NOT ONLY Engineering Challenges of 21st Century

Improvement of Human Life

http://www.engineeringchallenges.org/

Higher Education 4.0 (TANGIBLE)

Challenged by emerging technologies in Industrial 4.0, smart services and globalization

Hidden Elements of 4.0IR (INTANGIBLE)

Powered by character building, high order thinking, multiple intelligences, mind and hands, soft skills, lifelong learning to face new challenges
10 Shifts to Support the Attainment of System and Student Aspiration

Malaysia Higher Education Blueprint
**UTM 4.0 for 4th IR Framework**

**SHIFT 8**  GLOBAL PROMINENCE

**TALENTS**  **SHIFT 1** STUDENTS  **SHIFT 2** EDUCATORS

**21ST CENTURY CURRICULUM**  **SHIFT 4** TVET  **SHIFT 3** LIFE LONG LEARNING

**SHIFT 10** LEARNING DELIVERY SYSTEMS

**SHIFT 7** RESEARCH & INNOVATION

**SHIFT 6** GOVERNANCE  **SHIFT 5** FINANCIAL

**SHIFT 9** 4.0 TECHNOLOGIES & APPLICATIONS

Learning Analytics  Gamification  AI & Robotics

**SHIFT 8**

Learning Analytics  MOOCs  Individualisation

**SHIFT 7**

Research Alliance  HICOE/COE  Research Group  Partners/Collaborators  Student Innovation

**SHIFT 6**

Governance

**SHIFT 5**

Financial & Policies

**SHIFT 4**

TVET

**SHIFT 3**

LIFE LONG LEARNING

**SHIFT 2**

EDUCATORS

**SHIFT 1**

STUDENTS

**UTM 4.0 4IR Digital Nervous System**

**SERVICES**

4.0 Technologies  Experts  21st Century Learning Design

**RESEARCH**

HICOE/COE

**ACADEMIC**

CTL  UGS  SPS

**BIG DATA**

Artificial Intelligence

**LEARNERS**

Content Delivery  MOOCs  Blossom  Individualisation

**EDUCATORS**

Administrative Units  Collaborators

**COLLABORATORS**

Learners  Educators  Student Affairs  Faculties/Schools  UTMLEad

**ADMINISTRATIVE UNITS**

Industries  Other HEIs
3 Grand Challenges as Proof of Concept by UTM COEs

GC#1: Learning Technologies

GC#2: 21st Century Curriculum

GC#3: Learning Analytics

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GC#1: Learning Technologies: Gamification, AIS and Robotics

Exhibit 7: Most educational technologies are focused on developing foundational literacies.

- Competencies
  - Character Qualities
  - Foundational Literacies

- Personalized and adaptive content and curricula
- Open educational resources
- Communication and collaboration tools
- Interactive simulations and games

- Additional tools are strongly needed to develop competencies and character qualities

- Character Qualities:
  - Knowledge
  - Dreambox
  - Learners
  - Khan Academy

- Foundational Literacies:
  - Google Apps for Education
  - OneNote
  - Facebook
  - Ponder
  - Pearson
  - McGraw-Hill
  - Houghton Mifflin
Gamification Technology in Teaching and Learning

1. Sense
   - Leap Motion
   - Data Glove
   - Motion Capture
   - Brain Computer Interaction

2. Process
   - Augmented Reality
   - 3D Printing
   - Virtual Reality
   - Holograms

3. Display & Feedback
   - Advanced CGI
   - Computer Vision
   - Visualization
   - Simulation

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Gamification Technology in Teaching and Learning

Health, Safety, Environmental for Oil and Gas Industry

Centrifugal Oil Compressor for Oil and Gas

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Augmented Reality in Culture and Heritage

Galeri Memorial Tun Abdul Razak

Mobile Games and Apps

More than 150 mobile games/apps
Request sets from field
Generate optimized mission plan
Drones mission assignment
Guidance & Control

**Flagship Programme:**
**Digital Technologies for Oil Palm Industries**
- Harvesting Technology
  - Exoskeleton
  - Intelligent Harvesting
  - Harvesting Robot
- Data Driven Plant Management
  - Growth Monitoring
  - Pest & Disease Control
  - Fertilizer Management
  - Yield Prediction

**Flagship Programme:**
**Manufacturing 4.0**
- Industrial IoT Lab
  - CNC Machine, 3D Printer, Robotics Assembly, Intelligent Drone Delivery System, Automated Storage, Prototyping, Components Production, Consultancy, Training, Research
  - Production Optimization, Process Operational Efficiency, Predictive Maintenance, Real-time Info Display

**Flagship Programme:**
**Disaster Management**
- Intelligent Drones for Disaster Rescue Operation
  - IoT Lab Layout
  - Drones mission assignment
  - Guidance & Control

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**EXPERTS & TALENT DEVELOPMENT**
- CAIRO’s Comprehensive IoT Training Programmes
  - Embedded System, Internet Communication System, Artificial Intelligence, Data Analytics, Control & Instrumentation, Database System, Cloud Management
  - Training on System Integration & Maintenance for Agriculture 4.0 and Manufacturing 4.0
  - Awareness Programmes for Executives to Onsite Personnel

**KenalKayu – Wood Species Recognition System**
- Web-Based KenalKayu
- Handheld KenalKayu
  - Mobile
  - Small
  - Light
  - Fast
  - Accurate

**SYCUT – Syariah Compliant Chicken Slaughtering System**

**CR2 – Rehabilitation Robot for Wrist & Forearm**
- Cloud-Based Monitoring
- Interactive
- Modular
- Portable

**Flood/Landslide Simulation System**
- IoT Based Adaptive Fuel Map

**Lightweight Exoskeleton Suit for Oil Palm Harvesting**
InMotion Project in Relation to Industry 4.0

Innovative teaching and learning strategies in open modelling and simulation environment for student-centered engineering education

- an EU Grant project carried out in FKM (UTM), which aims to create new eLearning Materials for Computer Modelling and Simulation for Engineering (CMSE) field with Open Modelling and Simulation Environment platform (OMSE) based on innovative teaching strategies and creative learning approaches.

- InMotion target to train graduates, engineers, researchers from European Countries and Pacific Countries to be competent in the CMSE field and hence the realization of Industry 4.0.

International Partners

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GC#2: 21st Century Curriculum

Exhibit 1: Students require 16 skills for the 21st century

21st Century Skills and Learning Strategies (Source: Soffel, 2016, Website Editor, World Economic Forum)
The Impact of 21st Century Curriculum & 4.0 Technologies

Mastery of Key Academic Subject Area

UTM New Academia Learning Innovation (NALI)
21st Century Learning Model to support 4IR

<table>
<thead>
<tr>
<th>New academic academy</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Faculty members</td>
<td>Professors, inventors, entrepreneurs, Internship staff, fellows</td>
</tr>
<tr>
<td>Learning materials</td>
<td>Books, journals, experiences, Internet, internship Internship, students' business venture</td>
</tr>
<tr>
<td>Philosophy</td>
<td>Integration New pedagogy, RA</td>
</tr>
<tr>
<td>Funding</td>
<td>Grants, fees, VC, endowment, REITs Creative fund raising</td>
</tr>
<tr>
<td>Students</td>
<td>School leavers, mid-career, businessmen, early-career; life-long Top UG, PG from corporations, research</td>
</tr>
<tr>
<td>Venue</td>
<td>Campus, Internet, incubators, brands Wifi, 4G, MTDC, Proton</td>
</tr>
<tr>
<td>Learning modes</td>
<td>Lectures, tutorials, lab, studios, peer instruction, internship, incubators, experiential learning, 5 minds NEW PEDAGOGY: learner-centric, Silicon V-culture, GOP, ethics</td>
</tr>
<tr>
<td>Outcomes</td>
<td>Degrees, expertise, business models, capital, networks, culture JOB CREATION: micro-credit, spin-off, projects</td>
</tr>
</tbody>
</table>
The impact on people

"One of the features of this 4th Industrial Revolution is it doesn’t change what we are doing but it changes us" – It changes the role of educators in UTM!

Focus:
Open access learning (BLOSSOMS, MOOC, STEMazing etc.) with pedagogy, andragogy, and heutagogy approaches enhances creativity, reduce gaps (every individual poor or rich able to get access to quality education), empower many people to improve their living conditions.

Source: http://www3.weforum.org/docs/WEF_EGW_Whitepaper.pdf

MOOC

- A new deal on lifelong learning
- Adult learners: It is vital to ensure that the 3 billion people already in the workforce get access to quality training and learning opportunities;
- Other than andragogy and pedagogy, HEUTAGOGY approach is required to cater professionals/ working individuals.
- Develop more MOOC Courses for Technical and vocational education and training (TVET)

BLOSSOMS & STEMazing

While increasing the STEM-literacy of the population is certainly very important, currently these subjects are often taught in a way that reinforces a disconnect between sciences and humanities and existing education gender gaps, and focuses on theory over application and experiential learning
- bridging gap between lower and higher education
- Teachers have regular opportunities to refresh their own skills and knowledge.

Source: http://www3.weforum.org/docs/WEF_EGW_Whitepaper.pdf

21st Century Curriculum for Engineering Education

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Malaysia

3035 academics
training developed based on
research by CEE
/Public & Private Universities,
Colleges, Schools, Petrosains
SCL, AL, CL, PBL, PDPBL, TRIZ,
HOTS, LCS, Assessment, OBE, Math
Thinking, EER

Learning Analytics:
Data and Social Media
A lot of interest about learning analytics in both countries.
At different stages of development in terms of the learning analytics journey.
The use of an LMS varies considerably between countries and that influences the survey findings in terms of usage and relevance.
Expectations and understandings vary considerably due to context and infrastructure.
Professional development – more interest in attending in Australia when it is offered. In Malaysia it is not available.
Interesting finding regarding ethical concerns which could be a reflection of institutional policies, understandings or cultural difference.
The Google Online Marketing Challenge is a unique opportunity for students to experience and create online marketing campaigns using Google AdWords. Over 110,000 students and professors from almost 100 countries have participated in the past 9 years.

The Global Academic Panel

Dr. Hazairin Haji Abidin is a Senior Lecturer at Universiti Teknologi Malaysia. She teaches E-Marketing, E-Business and other marketing courses to both graduate and undergraduate students. Dr. Hazairin earned her PhD from The University of Western Australia, and her research and consultation networks include effective Internet use in organizations, application of Internet in tourism industry and destination marketing. Dr. Hazairin's passion is teaching, and she believes that learning goes beyond the classroom. Her publications have appeared in Tourism Management, Journal of Computer Mediated Communications, International Journal of Hospitality Management and Journal of Information Technology and Tourism.

Digital Transformations (DX)
The application of 3rd Platform–related technologies to fundamentally change the way something is done, generally with a design-led approach to business process redesign.

WHAT IF...

PROFITABILITY

NET PROMOTER SCORE

CUSTOMER ACQUISITION
The DX Journey

Leadership transformation  Omni-experience transformation  Information transformation  Operating model transformation  Worksource transformation

Data  Strategy  Technology  Process  People

Which areas are being transformed?

Leadership transformation  Omni-experience transformation  Information transformation  Operating model transformation  Worksource transformation

An “Outside in” Business Environment  Blend Physical and Digital Experiences  Information as a Competitive Advantage  New Digital Revenue Streams  Ecosystem-based Workforce

Source: IDC Digital Transformation Research Practice, 2017
Omni-Experience DX
Leaders create market-altering interactive experiences

Domino's Pizza
Delivering great CX - Social croudsourcing/Datafication & re-tailling

Chow Sang Sang
Delivering personalized experiences - AR

Domino Pizza Mogul
Yihaodian E-Commerce
Operating Model DX
Leaders challenge traditional business and operating models

Yihaodian
Challenging traditional retail models with augmented reality

TeatreNeu
Disrupting the arts scene with an innovative business & operating model

Pay Per Laugh
Conclusion & Future outlook

- Challenges of future jobs
- Disruptive innovations
- Individualization of learning
- Accreditations of higher education academic programs
- Innovations as key for University 4.0
  - Inequality represents the greatest societal concern associated with the Fourth Industrial Revolution
Thank You
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Sources: