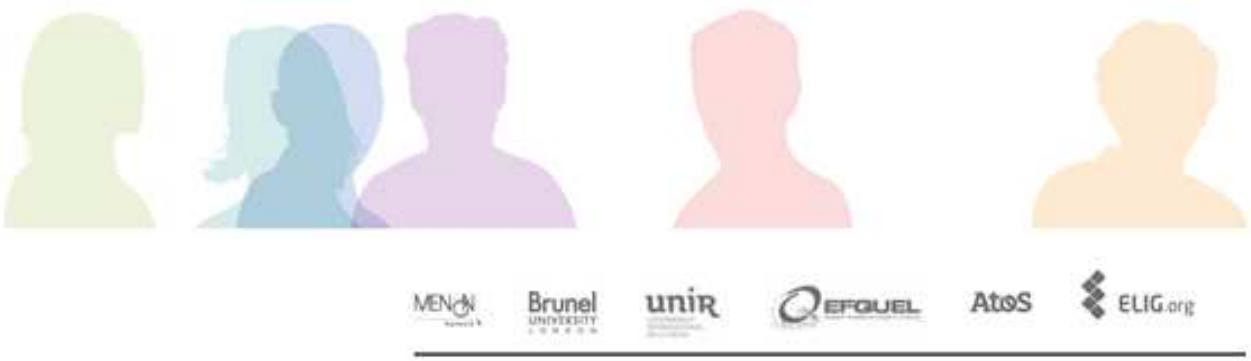

Experts Group Workshop

How theory and technology evolution can support learning practices?

ATOS Innovation Centre
4 Triton Square, Regent's Place, London, NW1 3HG
March 14th, 2014

SEVENTH FRAMEWORK PROGRAMME

HoTEL Holistic Approach to Technology Enhanced Learning

Hosting Innovators, Rooms for Success.

Emerging technologies: Reference material

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Introduction

Innovation happens in three distinct phases: 1) emergence, 2) incubation, and 3) industrialisation of ideas in form of applicable technologies and their mainstream adoption. In addition to the number of ideas created in the first phase, a critical success metric is the reduction of the time to move ideas from phase one to the two later phases. In the case of innovation in TEL that critical success metric is seen as the effectiveness and mainstreaming of new ways of using ICT to support learning within reasonable time considering the different speeds of evolution between technologies and learning practices. And this is one of the final endeavours of the HoTEL project through the design and testing of an Innovation Support model in TEL to speed up the mainstreaming of new relevant and meaningful ways to use technologies for learning purposes[1].

The present document is one of the reference materials to be used in the strategic one-day Experts Group workshop that will take place in ATOS Innovation Centre in London next March 14th. This workshop aims at providing a framework for brainstorming in order to improve together the HoTel Innovation Support Model based on how the recent developments in technology areas can affect the way we are organizing, delivering and managing learning and education in the future. The final endeavour of the workshop is to brainstorm on emerging/disruptive technologies and then map them to learning theories and new learning practices in order to come up with a set of ideas to make the HoTEL ISM more useful and fitting for practice.

The information about emerging technologies presented in this document will be used as starting point for the brainstorming session aimed at completing the ICT evolution map and defining how these technologies can be used in the implementation of the different learning practices introduced in the other reference material for this workshop.

1. Emerging technologies

Next we present a brief introduction to 10 emerging technologies which were selected in previous research activities of the HoTEL project during last year[2]. We considered some available sources that provide us with information about emerging technologies, their maturity and practical applicability to select the set of technologies to be further explored during the workshop. We found feasible access

[1] Project objectives description in the HoTEL DoW Part B, page 3
[2] D 1 1 2_Emerging Technologies Landscape report available at http://hotel-project.eu/content/d112-emerging-technologies-landscape-report

to the Gartner Annual reports [4][5][26][27], the MNC Horizon reports[22][23][24][25] and IPTS MATEL study [1] as data sources: the two latter sources supplied information about specific technologies to support educational processes meanwhile the first one was used to gather information about general IT technologies.

For each technology a short definition is presented and it is complemented with information explaining the rationale behind their relevance at the time of this analysis: which are the latest developments related to such technology and what examples of working prototypes or commercial products are currently available. Also it is included some initial reasoning on how that technology can be used to support the implementation of some of the learning practices described in the other reference material for this workshop. It is specified whether the technology can be used as main element to support the implementation of a learning practices or it is one of the additional technologies that can enhance such implementation.

1.1 Augmented reality

Augmented reality (AR) refers to the real-time use of information in the form of text, graphics, audio and other virtual enhancements integrated with real-world objects. It is this "real world" element that differentiates AR from virtual reality. AR aims to enhance users' interaction with the environment.[3]

Why is this technology relevant now?
Augmented reality is not mature but it is an emerging technology in progress and still needs a lot of efforts to improve some of its most promised capabilities like activity recognition. According to the MNC studies it will be broadly adopted in 2-3 years [22] and Gartner studies [26] put them at the "Peak of expectations" (5 to 10 years).
Nevertheless, there are recent hardware and software developments and proven products that already allow implementation and testing of real AR applications.
This is the case of available hardware devices like the Google glass prototypes[4] which is the first prototype for consumer glasses specifically designed for augmented reality applications and is at the time of this writing under user evaluation. The results of such evaluations will determine whether the time for AR applications mainstream adoption can be reduced.
In the case of software developments, the Metaio SDK[5] is a development toolkit with proven and complete AR solutions which includes advanced tracking and rendering engines for 2-D images ad 3-D objects. It is platform independent, so resulting applications can be deployed everywhere (in any device)

Support for learning practices
The use of AR technologies can be considered as indispensable for implementing some Work focused learning experiences like those related to engineering extreme conditions; AR allows participants to interact with objects in a real environment but also includes some information that is not visible at first glance within the location, which gives them a deeper insight of the process under study and help to simulate extreme conditions.
This type of technologies can be also used as additional support to enhance the implementation of: Game-based learning experiences or Gamified learning providing some extra information in form of hints that can help participants to improve their game experience performance, achieving milestones and higher scores which are directly related to predefined learning goals.

[3] Augmented reality definition http://www.gartner.com/it-glossary/augmented-reality-ar/
[4] Google Glass project http://www.google.com/glass/start/
[5] Metaio Software Development KIt http://www.metaio.com/sdk/

1.2 Learning analytics

Learning analytics represent the application of "Big data" to analytics in Education. Learning analytics is the measurement, collection, analysis and reporting of data about learners and their contexts, for purposes of understanding and optimising learning and the environments in which it occurs[6]. In many cases it combines some Artificial Intelligent approaches like Intelligent Agents when providing support for personalization of the learning experience.

Why is this technology relevant now?

The MNC Horizon reports on HE [23, 24, 25] predict that Learning Analytics applications will be wide adopted within 2-3 years. Meanwhile the Gartner 2012 edition put it as emerging technology at the "Peak of expectations" stage predicting that in 2 years will be broadly adopted.

Currently there are available research and development of platforms with Core analytic tools (or engines) that include adaptation of learning /personalization, interventions and dashboards[7]. There are also other ready to use LA solutions like Acrobatiq Learning Dashboard[8], which complements the Intelligent Courseware solution in gathering actionable insights on student learning performance across a wide range of courses. It will be also launched later this year as SaaS Enterprise Version of Learning Dashboard.

Support for learning practices:

Learning analytics is a powerful set of tools that will enhance the implementation of any learning practice in the following ways according to the Society for Learning Analytics research [28]

- Reduce attrition rates through early detection of at-risk students and generating alerts for learners and educators.
- Personalize and adapt learning process and content, ensuring that each learner receives resources and teaching that reflect their current knowledge state.
- Extend and enhance learner achievement, motivation, and confidence by providing learners with timely information about their performance and that of their peers, as well as providing suggestions on activities and content that address identified knowledge gaps.
- Makes better use of teacher time and effort by providing information on which students need additional help, which students are candidates for mentoring others, and which teaching practices are making the biggest impact.

[6] Learning analytics in the CFP of the 1st International Conference on Learning Analytics & Knowledge (LAK 2011) https://tekri.athabascau.ca/analytics

[7] Open Learning Analytics platform http://solaresearch.org/OpenLearningAnalytics.pdf

[8] Acrobatiq Learning Dashboard http://acrobatiq.com/products/learning-analytics/

- Higher quality learning design and improved curriculum development processes through the utilization of data generated during real-time instruction and learning activities.
- Interactive visualizations of complex information will give learners and educators the ability to "zoom in" or "zoom out" on data sets, depending on the needs of a specific teaching or learning context.
- More rapid achievement of learning goals by giving learners access to tools that help them to evaluate their progress and determine which activities are producing the best results.

1.3 Gesture based computing

Gesture-based computing allows users to engage in virtual activities with motions and movements similar to what they would use in the real world, manipulating content intuitively. The idea that simple gestures and natural, comfortable motions can be used to control computers is opening the way to a host of input devices that look and feel very different from the keyboard and mouse — and that are increasingly enabling the supporting devices to infer meaning from the movements and gestures we make [22].

Why is this technology relevant now?

According to the MNC Horizon STEM+ report [22] the Gesture-based computing time-to adoption is within the next 4-5 years and defines it as emerging technology. Nevertheless, nowadays there are certain commercial hardware/software products that supports gesture based User Interfaces. For instance, the Samsung Galaxy S4 features AirView and Air Gesture[9] which allow user to hover in order to visualize more information or to swipe to turn to the next page.

Another example is the Leap Motion Controller[10] with its supporting software which is an small device that sits in front of a PC display and turns Windows into a gesture based IU and it is mostly use for gaming in 3D.

Support for learning practices

This type of technology can be used as additional support to enhance the implementation of Inquiry based learning experiences because it will make simpler and more natural learners' interaction with the presented contents/materials, it will facilitate their discovering paths when they follow their own interests in relation to the plan proposed by the teacher/facilitator. It will also improve the implementation of Personal Learning environments in terms of interaction, facilitating the access to the different elements of the personal dashboard.

[9] Samsung Galaxy S4 AirView feature http://www.pcmag.com/slideshow/story/309249/9-cool-features-on-the-samsung-galaxy-s4/1
AirGesture http://www.pcmag.com/slideshow/story/309249/9-cool-features-on-the-samsung-galaxy-s4/9

[10] Leap Motion Controller
https://www.leapmotion.com/?utm_source=CJ&utm_medium=AFF&utm_content=11514579&utm_campaign=2470763&tracking=CJ

1.4 Wearable Technology

Wearable computers and their interfaces, like a wrist-mounted screen or head-mounted display, are designed to be worn on the body and they enable mobility and hands-free/eyes-free activities[11]. Wearable technology will enrich the capabilities of interaction provided by Augmented reality.

Why is this technology relevant now?

The MNC Reports [22, 23, 24, 25] foresee the Wearable technologies' time of mainstream adoption in the next 4-5 years due to the fact there are different wearable technology approaches are on piloting stages.

Many hardware working prototypes are available and that facilitates the definition and testing of possible wearable technologies applications. Some examples are the following: The HC1 Headset computer[12] is a piece of wearable technology developed by Motorola, that consist of a headset that allow the instant access to documentation or start collaboration with other team members with simple users' voice commands or head movements. Keyglove[13] is a wireless, open-source input device that user wears over the hand to control devices, enter data, play games, and manipulate 3D objects.

Support for learning practices

The use of this type of technology can be considered as indispensable for implementing some Work focused learning experience to provide support to those training processes in dangerous conditions, where the use of wearable technologies can help to detect conditions where the trainer needs to perform specific tasks or could be affected due to the changes in the environment. This technology can be also become additional support to enhance the implementation of Microlearning or Seamless learning practices since it will favour a better learner interaction with the environment where these learning experiences may occur.

[11] Wearable computer definition from Gartner Glossary http://www.gartner.com/it-glossary/wearable-computer/

[12] HC1 Headset computer http://www.motorola.com/Business/US-EN/Business+Product+and+Services/Mobile+Computers/Wearable+Computers/HC1

[13] Keyglove http://www.keyglove.net/

1.5 Internet of Things

The Internet of Things (IoT) is the network of physical objects that contain embedded technology to communicate and sense or interact with their internal states or the external environment[14].

Why is this technology relevant now?

The MNC Reports [24,25] predict the time of mainstream adoption of IoT in the next 4-5 years as it is a really new technology. While there are examples, such as the Libelium[15], of what the Internet of Things might look like as it unfolds, it is still today more concept than reality. Although the underlying technologies that will make it possible — smart sensors that can easily be attached to everyday objects to monitor their environment or status; new forms of low-energy radio transmission that can enable the sensor to send its information wirelessly or via electric lines to a network hub; and an expanded address space for the Internet — are all well understood, easily mass-produced, and inexpensive. Their integration in ready-to-use applications is yet not available.

Nevertheless many research activities are being conducted in this area and it is important to remark the relevance of the work Future Internet Asociation (FIA) and related projects like IoT-A[16] in defining the IoT Architecture Reference Model. This reference model provides building blocks to support interoperability, smooth interaction, integration and distributed orchestration of connected devices and will facilitated the creation of platforms and eventually practical applications.

One interesting example of working project related to IoT is Scratchable Devices[17]. It is a research project at Rutgers University that is enabling end-users to use the graphical programming language Scratch to program household devices, such as coffee makers, lamps, and alarm clocks. It enables the average person to program complicated scheduling and repetition, rich interaction between devices, and logical decision making. The Scratch programing language[18] has been designed with learning and education in mind and it allows learners to develop important design and problem-solving skills, learning how to think creatively, reason systematically, and work collaboratively. Another project is Amarino[19], developed by MIT, is a toolkit that allows users to control the lights in a room, and detect exposure levels to radiation or other potentially harmful environmental factors through their smartphones.

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[14] Internet of Things definition from Gartner Glossary http://www.gartner.com/it-glossary/internet-of-things/

[15] Libelium http://www.libelium.com/top_50_iot_sensor_applications_ranking/

[16] Internet of Things Architecture IoT-A project http://www.iot-a.eu/.

[17] Scratchable Devices http://scratchabledevices.com/

[18] Scratch programming language http://info.scratch.mit.edu/About_Scratch

[19] Amarino http://www.amarino-toolkit.net/

Support for learning practices

This type of technology when will be mature can be used as additional support to enhance the implementation of Seamless learning experiences since the information gathered from the different networked objects will contribute to improve the support of continuous, fluid learning experiences.

1.6 Context aware computing/ Context enriched services

Context-aware computing (CAC) centers around the concept of leveraging information about the end user to improve the quality of his interaction since it anticipates immediate needs and proactively offer enriched, situation-aware and usable content, functions and experiences.[20] Meanwhile the term "context-enriched services" describes software that uses information about an end user's environment, community, process and identity to enrich the functionalities provided to the user. The term denotes services and APIs that use information about the user to optionally and implicitly fine-tune the software action with better situational awareness. Such services can proactively push content to the user at the moment of need, or suggest products and services that are most attractive to the user at a specific time.[21]

Why is this technology relevant now?

The 2012 Gartner Report [26] defines Context aware computing on the "On the rise of expectations" stage and foresees that it will be broadly adopted in the 5 to 10 years. Therefore it can be considered as emerging and "not-mature" technology, it is important to stress that underlying technologies like geographical positioning systems and environmental sensors are already mature and wide available but others like facial gesture recognition, voice recognition (speech analysis) or detection of other individuals' presence are still under development.

Examples of available and mature supporting technologies are GPS and Bluetooth and they provide granular level of location awareness. In addition Context aware Software Development Kits like QualCOMM Gimbal[22] is currently ready to be used and it allows developers to design mobile apps for user engagement by providing real-time context and location awareness.

Support for learning practices

This type of technology in its current status can be used as additional support to enhance the implementation of Personal Learning environments since this type of technology facilitates not only the gathering of information of the learning process context seen as computing environment (PC, tablet, peripherals, network connections), user context (profile, location, time, emotional state, developed activities) and the physical context (light, noise levels, temperature, traffic conditions). But also it allows the implementation of dashboards to provide support to learners in the management and personalization of their own learning process.

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[20] Context aware computing definition from Gartner Glossary http://www.gartner.com/it-glossary/context-aware-computing-2

[21] Context enriched services definition from Gartner Glossary http://www.gartner.com/it-glossary/context-enriched-services/ .

[22] QualCOMM Gimbal SDK https://developer.qualcomm.com/mobile-development/add-advanced-features/context-aware-gimbal

1.7 Immersive technologies

Immersive technology refers to technology that blurs the line between the physical world and digital or simulated world, thereby creating a sense of immersion[23]. A fully immersive perceptually-real environment will consist of multiple hardware/software/applications components to provide perception and interaction with the environment. In the case of visual perception required technologies can be 3D display, Holography, head-mounted display. For Auditory perception are needed 3d audio effects, Surround audio. For Tactile perception haptic technologies can be used. Meanwhile Machine olfaction and artificial flavour are used for olfaction and gustation respectively. In addition the interaction is offered through the following technologies Gesture recognition, Speech recognition, Brain-computer interface. Usually the software is provided by AI and virtual worlds applications.

Why is this technology relevant now?

This set of technologies can be considered as "not-mature" emerging technologies. Although some of the technologies belonging to this trend that facilitate auditory (3d audio effects, Surround audio) and tactile perception (haptic technologies) are already available, others like 3D displays are slowly getting mainstreamed but others to support olfaction and gustation perceptions are more concepts than real products.

At the time of this writing Haptic technology has been making their appearance in everyday products such as smart phones that vibrate when touched and make possible for a person to feel a virtual object. 3D displays and glasses from Philips, Sony, Playstation had reached the mainstream distribution.

Support for learning practices

Bearing in mind the novel nature of these technologies their application to education represents some challenges. For instance from HCI perspective on how to design immersive experiences that allow to effectively manage the facilities and opportunities the technology offer. Also means to check to which extent the stated learning goals are achieved through the immersive experience.

Immersive technologies can be considered as ideal support of user interaction with an interesting potential for learning because it allows learners to get better understanding of the objects and processes represented in the virtual environment situations they are immerse in. These technologies can be used as additional support to enhance the implementation of Work-focused learning experiences since the availability of this type of technologies facilitate simulation of dangerous environments and allow the immersion and interaction of learners with elements of such context. This also applies for the training related to mastering the use of very expensive infrastructure. Also the implementation of Gamified or Game based learning experiences can benefit from the enhanced support of this technology

[23] Immersive technologies definition http://en.wikipedia.org/wiki/Immersive_technology

because the immersion provided it helps fostering skills like exploration and self-management.

1.8 3D printing

3D printers use a variety of very different types of additive manufacturing technologies, but they all share one core thing in common: they create a three dimensional object by building it layer by successive layer, until the entire object is complete[24]. Additive 3D printers deposit resin, plastic or another material, layer by layer, to build up a physical model. Inkjet 3D printers image successive layers of plastic powder, hardening each layer on contact, to build up the piece. The size of the part varies with the specific manufacturer's printer and whether support structures are required.

Why is this technology relevant now?

3D fabricating technologies have been available since the late 1980s and have primarily been used in the field of prototyping for industrial design. 3D printer working prototypes appeared in 1984 and the first working printer was designed by Charles W. Hull of 3D Systems Corp[25] and this company still commercializes such type of devices.

More recently, the 3D printing quality has increased, and printer and supply costs have decreased to a level that broadens the appeal of 3D printing to a wider range of businesses, schools and consumers. Another example of available 3D printing devices are those commercialized by Stratasys[26]

Also had been large growth in the sales of these devices in the last decade, their price has dropped substantially to the extent that some studies analyse that soon it will be possible to have 3-D printing at home.

Support for learning practices

3D printing technologies can be consider as indispensable for implementing some Work focused learning experiences where special, rare or high complex materials are required, for instance in Biotechnology and tissue engineering experiments where human organs and parts can be built using this type of technology.

It can also provide an additional support to enhance the implementation of Inquiry Based learning experiences related to the use or creation of expensive materials or those aimed at the definition of conceptual modelling in Architecture or Ergonomic studies or functional prototyping.

[24] 3D printing definition from Gartner Glossary http://www.gartner.com/it-glossary/3d-printing/
[25] 3D Systems Corp http://www.3dsystems.com/
[26] Stratasys http://www.stratasys.com/3d-printers

1.9 Audio Mining/Speech analysis/Natural language processing

Audio mining/speech analytics embrace keyword, phonetic or transcription technologies to extract insights from pre-recorded voice streams[27] Speech analysis and natural language processing generally use Artificial Intelligence approaches like Machine Learning algorithms.

Why is this technology relevant now?

Artificial Intelligence and Machine learning approaches had been around for decades but recently we found available stable prototypes and toolkits like transLectures-UPV toolkit (TLK) [28] which facilitates the pre-processing, training and recognition of standard acoustic systems and allows Automatic Speech Recognition in real time using Machine learning mechanisms,.

Also there are available commercial products based on speech analysis like hound-it[29] from Aurix. It includes desktop speech search that utilises high accuracy, high performance speech technology and is capable of complex searches to significantly reduce the resources required to analyse audio recordings.

Support for learning practices

Audio mining and speech analysis provides an insight that can be used to classify audio streams, trigger alerts/workflows, and help to drive operational and trainer/learner performance through the learning process. This type of technology can be used as additional support to enhance the implementation of any learning practice that will require personalization in terms of translating or transcribing its contents. In addition the use of this type of technology can have an impact on enriching the facilities of interaction offered by Context aware computing/enriching services.

[27] Audio –mining –speech analysis definition from Gartner Glossary http://www.gartner.com/it-glossary/audio-mining-speech-analytics/

[28] transLectures-UPV toolkit (TLK) http://www.translectures.eu/tlk/features/

[29] hound-it http://www.aurix.com/pages/4835/hound-it_1.3.htm

1.10 Computer Brain Interfaces/Neuro-gaming

Brain-computer interfacing (BCI) research has been motivated for years by the wish to provide paralyzed people with new communication and motor abilities, so that they can once again interact with the outside world [3]. But during recent years, BCI research has been moving into applications for healthy people and the area of games had received a lot of interest, as gamers are often among the first to adopt any new technology and the use of this type of interface facilitates the adaptability of the game to the player's preferences and mental status.

Why is this technology relevant now?

During the last decade it has been a lot of research related to neuroscience technologies and currently there are available stable products like EEG Biosensors (electroencephalogram) that digitalize analog electrical brainwaves to power user interfaces of games or educational applications like in the case of ThinkGear™ AM[30] Other commercial product available is the Mindwave Education device[31]: It safely measures brainwave signals and monitors the attention levels of students as they interact with math, memory and pattern recognition applications.

Support for learning practices

This technology has been mainly used in the implementation of Game-based learning but it can be used to enhance the implementation of any other learning practice because it allows a more precise interpretation of the learner's mental status since it facilitates monitoring the brainwaves and learner's levels of attention, stress, relaxation in order to personalize his learning paths offering different contents, activities according to his mental levels.

[30] ThinkGear™ AM http://neurosky.com/products-markets/eeg-biosensors/hardware/

1.11 Additional information

The technologies previously presented had been spotted during the research activities carried out during the first year of the HoTEL project. Next we briefly present the time foreseen for their mainstream adoption according to the bibliographical sources consulted. Each row of the table includes the information about the studied technology with its ICT Knowledge category also considered as technology clusters in the previous research of this project (cluster from desk research/category from Field Research) [32]; and the foreseen time of adoption. The contents of this table aim at providing some reference for the definition of the evolution of IC technologies map that will be carried out in the workshop during the 2nd session.

[32] D 1 1 2_Emerging Technologies Landscape report available at http://hotel-project.eu/content/d112-emerging-technologies-landscape-report

Table 1. *The foreseen time for mainstream adoption of selected technologies.*

Selected Technologies			**Time for mainstream adoption**				
Cluster/Desk research	Cluster MATEL/Gartner	**Name**	**Time of adoption from Horizon reports 2012, 2013[22][23][24][25])**	**Emerging Technologies Gartner 2012[26]**	**Emerging Technologies Gartner 2011[27]**	**Emerging Technologies Gartner 2010[3]**	**MATEL study. Support educational changes in the next 5-10 years [1]**
Augmented reality	Visualization/Simulations:	**Augmented reality**	2-3 years	at the Peak (5 to 10 years)	at the Peak (5 to 10 years)	Reaching the peak (5 to 10 years)	N/A
Data Mining/AI/ Machine Learning	Data mining and social analytics	**Learning analytics/**	2-3 years	at the Peak (2 years)	Reaching the Peak (2 years)	Reaching the Peak (2 - 5years)	N/A
Human computer interaction (HCI)	Interfaces/ Interaction	**Gesture based computing**	4-5 years	N/A	N/A	N/A	N/A
Human computer interaction (HCI)	Interfaces/ Interaction	**Gesture Control**	N/A	Sliding into the Through (2- 5 years)	N/A	N/A	N/A
Human computer	Interfaces/ Interaction	**Gesture Recognition**	N/A	N/A	Sliding into the Through (2-5	N/A	N/A

Selected Technologies			Time for mainstream adoption				
Cluster/Desk research	Cluster MATEL/Gartner	**Name**	**Time of adoption from Horizon reports 2012, 2013[22][23][24][25])**	**Emerging Technologies Gartner 2012[26]**	**Emerging Technologies Gartner 2011[27]**	**Emerging Technologies Gartner 2010[3]**	**MATEL study. Support educational changes in the next 5-10 years [1]**
interaction (HCI)					years)		
Ubiquitous computing (UC)	Pervasive computing	**Wearable Technology**	4-5 years	N/A	N/A	N/A	N/A
Ubiquitous computing (UC)	Devices and connectivity/ Pervasive computing	**Internet of Things**	4-5 years	On the rise (more than 10years)	N/A	N/A	N/A
Ubiquitous computing (UC)	Pervasive computing	**Context aware computing**	N/A	On the rise (5 to 10years)	On the rise (more than 10 years)	N/A	N/A
Ubiquitous computing (UC)	Pervasive computing	**Context enriched services**	N/A	On the rise (5 to 10years)	On the rise (more than 10 years)	N/A	N/A
Games and Virtual Worlds	Visualization/Simulations/Interactions	**Immersive technologies**	N/A	Sliding into the Through (5 to 10 years)	Sliding into the Through (5 to 10 years)	N/A	N/A
Innovative material creation/	Material's Design and creation	**3D printing**	4-5 years	Sliding into the Through (5 to 10 years)		N/A	N/A

Selected Technologies			Time for mainstream adoption				
Cluster/Desk research	Cluster MATEL/Gartner	**Name**	**Time of adoption from Horizon reports 2012, 2013[22][23][24][25])**	**Emerging Technologies Gartner 2012[26]**	**Emerging Technologies Gartner 2011[27]**	**Emerging Technologies Gartner 2010[3]**	**MATEL study. Support educational changes in the next 5-10 years [1]**
Prototyping/ Conceptual modelling							
Data Mining	Data mining and social analytics	**Audio Mining/Speech analysis**	N/A	Sliding through (5 -10 years)	N/A	N/A	N/A
Human computer interaction (HCI)/ NeuroSciences	Interfaces/ Interaction	**Computer Brain interfaces**	N/A	Sliding into the Through (5 to 10 years	N/A	N/A	N/A

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[33] HoTEL got access to the in-progress results of the MATEL study, which is formally ending at the time of this writing but an official report has not been published yet.

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