

## **TWG 1: Technology developments: How human computer interactions change with technological innovation**

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Innovations in technology are challenging our beliefs and practices in teaching and learning. The content-orientated curriculum and lecture-based pedagogy can no longer meet the demands of the 21st century and the needs of diverse learners. Lately, there is convergence on the part of educators and learners in responding to the digital age. Curriculum movements such as NGSS are pushing towards process-orientated learning while students are making use of their electronic devices for learning purposes rather than entertainment alone. Looking to the future, then, we identified six technologies that will impact interfaces and in turn, teaching and learning, in the next 3-5 years: robots, wearables/mobile/sensors and controllers, natural language, AR/VR/3D, the cloud, and learning analytics. These technologies not only afford all learners, struggling learners to accelerated learners, opportunities to have a personalized, authentic, and never before possible learning experience, but they also give access to learning all the time and everywhere.

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### **Issues and Assumptions:**

- Technology affords all learners opportunities to experience unique, authentic, high risk, never be for possible phenomena.
- Technology affords all the time and everywhere learning
- Internet-connected technology is readily accessible.

### **Identified Current Misalignments:**

- Traditional curricula focus on content, but digital technology affords a focus on process.
- Currently, technology is typically used to make traditional learning better as opposed to leveraging opportunities afforded by digital technology to make learning more experiential for all learners.
- Disconnect between current teacher preparation programs and the needs of the teachers using digital technology in the classrooms
- The goals of the policymakers are not always aligned with the goals of educators. For example, educators focus on the whole child whereas policymakers focus more on efficiency and cost effectiveness.

### **Emerging New Alignments:**

- Students using mobile devices not just for entertainment.
- New curricula movements are putting process rather content first.
- New assessments are being developed for the newly adopted process-oriented curricula.
- User activities, interfaces, and contexts are beginning to come together.

### **Strategies and Actions:**

- **Policymakers need to:**
  - Experience the field and their policy decisions need to be informed by those experiences.
  - Allocate significant funds for a concerted effort in professional development to bring all K-20 educators into the digital age
  - Change the assessments to align with technology-enabled, new curricula and pedagogies.
- **Practitioners (i.e., Teachers) need to be:**
  - Engaged in ongoing, community-based and remunerated professional learning.
- **Researchers need to be:**
  - Engaged in classroom based research.

**Stories: Examples from Today, the Foreseeable Future, and the Unforeseeable Future!**

**Learning analytics (LA)**

- **Today:** Currently, LA focuses on tracking learners' interactions with the interface and depicts learning progression through teacher dashboards. In Japan, the ministry of education plans to introduce e-textbooks in all K-12 schools by 2020. E-book readers will record all reading activities such as page flips, bookmarks and annotations. Using these data teachers can develop evidence-based teaching strategies to respond to the individual needs of each student. Currently, the University of Kyoto is investigating e-book-based LA at five K-12 schools in Kyoto. The advancement in LA will enable smart interfaces to not only capture the learning processes, but also adapt to the needs of the learners to provide a personalized learning experience.

#### **Virtual Reality (VR)/Augmented Reality (AR)/3D/Mixed Reality (MR)**

- **Today:** VR enables learners to have experiences that, due to physical constraints of the real world, are simply not possible. VR fosters active and embodied learning by immersing learners in an authentic learning context (even inaccessible situations). NASA Space Science Education Consortium (NSSEC) built a VR clean room, which is a replica of a spacecraft assembly clean room at Goddard Space Flight Center. This VR experience gives users an idea of what it is like for NASA scientists and engineers during the build phase of a satellite. Various instruments and components of the satellite are interactive, along with a few other surprises. This exploration will lead to a better understanding of NASA mission science and engineering and give users a unique look into Goddard and other NASA facilities that otherwise would not be possible.

#### **Cloud-based Technology**

- **Today:** Cloud-based technology facilitates collaboration and knowledge building among individuals everywhere all the time. NetLogo is a cloud-based multi-agent programmable modelling environment. Third year students at the University of Balamand in Lebanon experimented with NetLogo to develop AI models based on agents and the environment. Students were presented with some scenarios, each of which facilitated agent design and simulation, thus satisfying the learning outcomes of the practical work of the course.

#### **Natural language**

- **Today:** In our daily lives, we speak with Alexa, Siri, and OK Google, on a regular basis. For example, how handy is it to ask Alexa when Delta flight 129 from Detroit is arriving in Dallas?

#### **Robotics**

- **Today:** Seymour Papert and his physical – and eventually virtual – “Turtle” pioneered the use of physical robots in the learning of coding.

#### **Wearables/mobile/sensors & controllers**

- **Today:** Mobile technology has made learning possible for all learners everywhere, all the time. For example, Scientists at NASA's Space Science Education Consortium (NSSEC) and the Center for Astrophysics | Harvard & Smithsonian (CfA) built the Eclipse Soundscapes App to make experiencing “total eclipses” accessible to everyone including people who are blind and visually impaired. Utilizing interfaces made possible by mobile device technology, accessible design practices, and innovative techniques, the Eclipse Soundscapes Project delivers an engaging and informative multi-sensory experience in real-time during an eclipse. Over 57,000 people used the app to learn about the eclipse, hear audio descriptions of eclipse features as they appeared in their local area, and interact with a “Rumble Map” that allows users to experience eclipse features through sight, sound, and touch.

**In the foreseeable future:** Learning analytics combined with machine learning will provide teachers with warnings about the specific needs of individual students and learning analytics will provide learners with more “scaffolded,” personalized learning experiences.

**In the unforeseeable future:** Affordable AR/VR/MR/3D (for example) will render all manner of previously unexperienceable experiences experienceable – for all learners. While the medium in which writers, painters, film makers, etc. work has limitations – for better or worse – digital technologies dangle the possibility that finally the medium is not a source of limitations. Indeed, the only limitations for creating, expressing, designing will be our own imaginations.