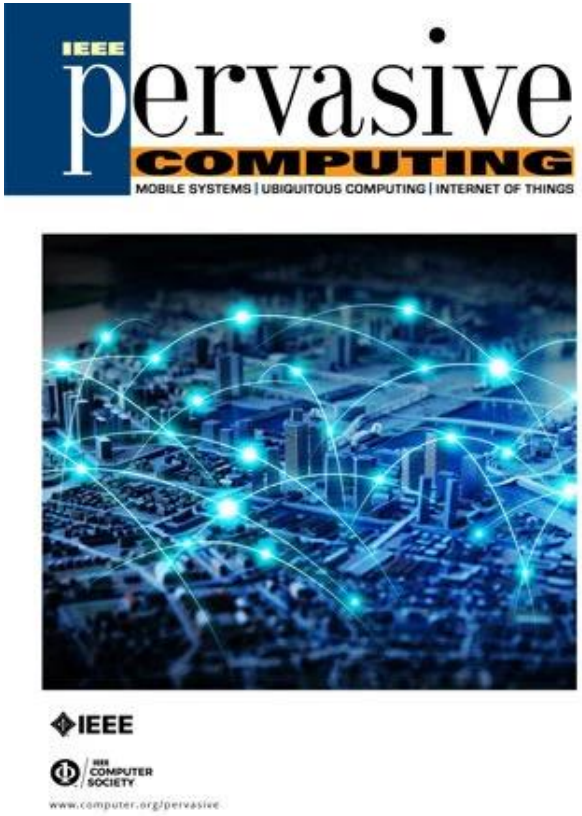

Grand Challenges for Pervasive Technology to Transform Pervasive Education

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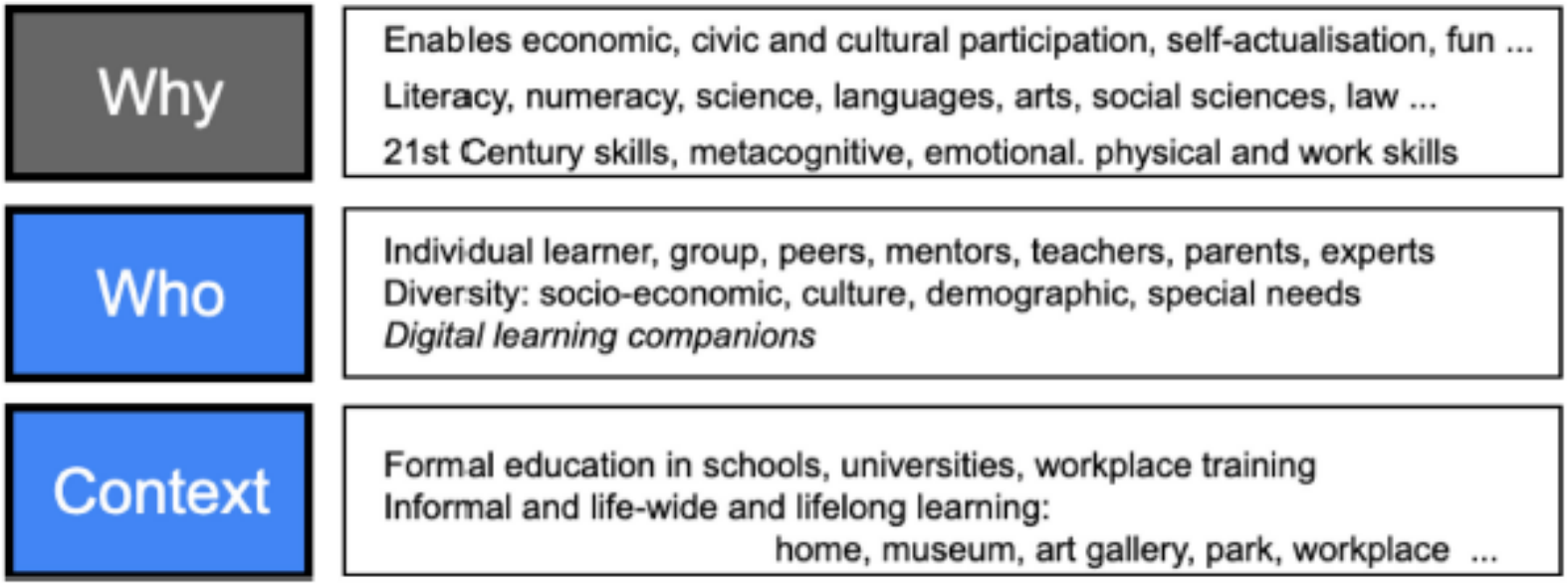
LIFELONG, LIFE-WIDE EDUCATION ACROSS DIVERSE CONTEXTS

PERVASIVE EDUCATION • OVERVIEW

These are three fundamental aspects of pervasive education.



PERVASIVE EDUCATION • WHY

- The first line has some of the many ways to describe lifelong and life-wide learning goals.
- There are already huge, indeed overwhelming, numbers of resources for diverse domains.
- Advanced computing technology has been particularly effective in creating teaching tools for formal subjects, such as maths, physics, and chemistry.
- The third line has generic skills that are relevant across domains.

PERVASIVE EDUCATION • WHO

- Characterize the different stakeholders.
- Much learning technology is for the individual learner.
- Humans are hyper-social creatures and this impacts learning.
- Artificial intelligence in education research has a long track record of work

PERVASIVE EDUCATION • CONTEXT

- Learning episodes can happen at diverse times and places.
- For example museums, parks, art galleries are important informal learning spaces but they are a small part of people’s life.
- There are educational challenge in the transfer learning between formal and other context and pervasive computing can be a helpful tool.

TECHNICAL AND INTELLECTUAL FOUNDATIONS FOR PERVASIVE EDUCATION

PERVASIVE TECHNOLOGIES • OVERVIEW

Worn and carried devices	Smart watch, glasses, rings and fabrics, skin sensors and interaction Smart phone, tablet, laptop, projected displays, augmented reality
Situated sensors, interaction devices	Cameras, heat, microphones, RFID Interactive surfaces, on tables and walls, tangibles, voice assistants
Data stores and interfaces	Multi-device and long-term, personal data stores, Learner Models Interactive surfaces, on tables and walls, Tangibles, voice assistants
Multi-disciplinary Foundations	Artificial Intelligence in Education (AIED), CSCL, EDM, LAK Learning sciences, Domain-specific pedagogy

PERVASIVE TECHNOLOGIES • CARRIED AND INTERACTION DEVICES

- This type of devices are currently used in wide range.
- They can monitor aspects like emotion and attention.
- This devices are valuable for pervasive education and learning because they produce resource with which is possible to produce new devices.

- The work on this field of study is very approximative.
- Respect on the work on devices this is very low.
- But for all the generated data nowadays, this infrastructures for storing are fundamental.

- Learner model is fundamental fro educational systems.
- A central concept for data management.
- An important implementation for tutoring systems.
- Now tutoring systems achieved a new level of learning improvement.
- it is what “knows” about the learner and how personalize interaction.

- There are many ethical and educational reasons for designing educational systems so that the learner controls their learning data and their use.

- Interfaces are required to analyze and control systems, n terms of what data it is allowed to collect, when it can do that and how it can use the raw data.

THE SIX GRAND CHALLENGES FOR PERVASIVE EDUCATION

First challenge: safeness, trustiness and controllability

This section summarize the six big challenges of pervasive education and compare them with a real-case example of a pervasive educational systems in the daily life of a physician called Sal in the year 2030. The challenges can be clustered in three big categories based on the context:

- **Lifelong, life-wide as well as formal class settings**, that is refer for pervasive contexts, across a learner's day and life, in formal learning settings.
- **Smart classrooms in formal settings**.
- **Contribution to education theory and practice**, that links between pervasive technology and educational theory and practice.

First challenge: safeness, trustiness and controllability

GC-1 Smart learning environments that feel *safe*, *trusted*, *scrutable* and *controllable.*

6am: *Sisyphus* interrupts Sal. *Sisyphus* can explain.
8am: Craft group and 2pm: class. Individual see their data and make personal notes.
7pm: Sal activates mind-wandering tracking.
Across contexts, Sal owns and controls all data about her.

The constant presence of devices and sensors, can arouse in many people a sense of unease and insecurity, a feeling that could be more deep in the case of very young individuals. To ensure effective teaching with pervasive tools, it's necessary to instill in the users a sense of security and confidence. The addition of scrutiny elements within the devices can be an effective solution to the problem: to having, in this case, the power to regulate the object, provides the user with more authority and consequently more confidence in its operation.

Second challenge: data exploitation

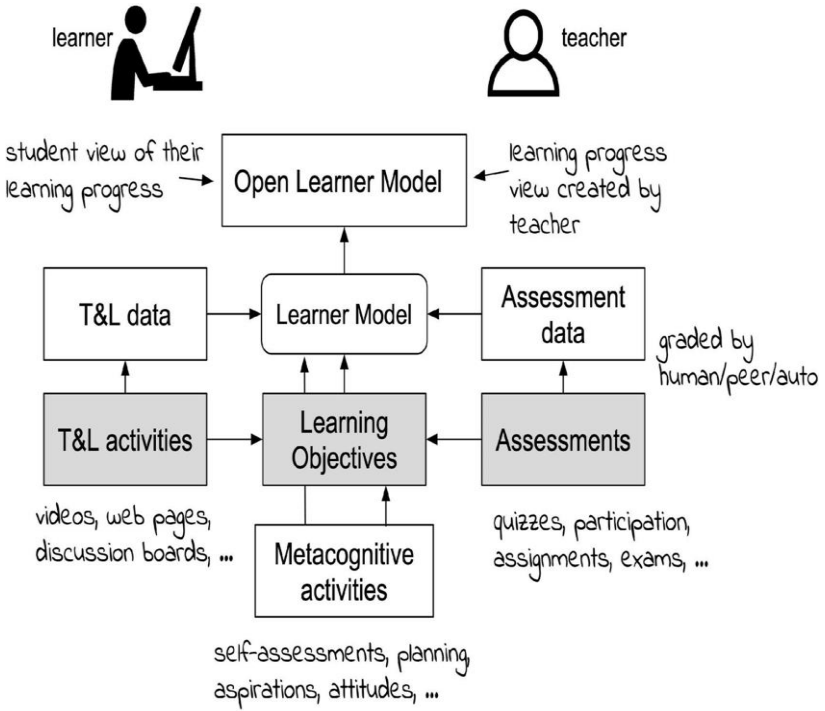
GC-2 Harness *long-term*, *rich* data for self-knowledge and shared understanding.

Self-knowledge.	8am: Sal studies new data and her previous reflection notes. 7pm: Sal tracks impact of new plan to reduce mind-wandering.
Shared understanding	8am: Craft group discusses data. 5pm: Sal and Student understand student's problem and plan action. 7pm: Greek students collaboratively learn.

Another important challenge concerns the ability to know how to better exploit the learning data acquired in order to obtain useful insight for the educational purpose; which is the best learner model? How to correct exploit self-knowing and shared understanding data? In the field of studies called Artificial Intelligence for EDucation (AIED), many studies have been carried out regarding teaching systems using Open Learner Models (OLM).

Open Learner Model (OLM)

The open learner model (OLM) is a means of visualizing the current knowledge or skill levels of learners in various ways, such as helping learners independently track, reflect on, and pace their learning processes so they can learn more effectively. OLMs have been used for many purposes: supporting metacognitive activities, for example planning, self-monitoring, and reflection; and supporting navigation and lesson sequencing in learning.



Third challenge: learning companion

GC-3 *Long-term* personal digital learning companions.

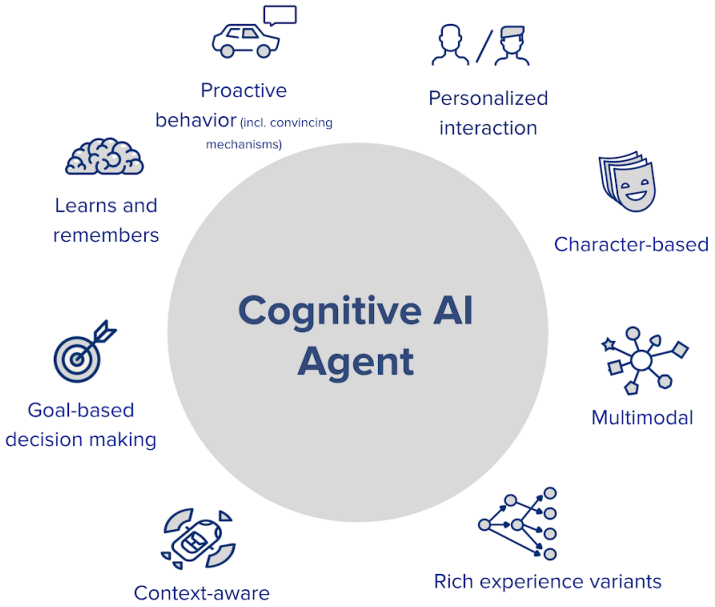
Sisyphus and *Sophia* are companions for decades, across multiple contexts each day. *Sophia* and *Theo* are companions for the years needed to learn a language.

The learning companion is a computer-based conversational agent that stays with the user over a period of time and gets to 'know' the learner. The learning companion will be designed to give practical support, guidance and focus to the independent learning activities of adults who wish to study topics of their own choice at home using a computer. The learning companion will be programmed to provide users with direct instruction and practice in appropriate computer and Internet applications.

Learning companion features

Studies have shown that changing various internal features of the learning companion has affected the learning outcomes of many users.
Some of these features are:

- Gender
- Age
- Race
- Accent



Fourth challenge: pervasive technology awareness and memory

GC-4 Augment classroom teacher's awareness and memory.

Awareness.	2pm: Sal needs to particularly attend to two students, also following class orchestration plan, and student progress.
Memory	2pm: Sal readily accesses details of each student at start and through the class.

Memory and awareness are two key elements of a pervasive technology. In education, the management of entire classrooms needs memory and awareness systems that can properly respond to feedback from multiple students. For example, the software should be able to analyze the environment and prioritize the student based on the situation. some simple approaches to the problem-such as hand up detection or a simple button that the user presses to get attention-have been implemented, along with other solutions that are significantly more effective.

Awareness solutions methods

Some sophisticated solution were deployed in order to resolve this problem:

- Emotion, engagement and mind wandering detection.
- Augmented reality classroom that can rapidly scan the environment and gain insight from each students action.
- As is shown in the image on the right, slitting the classes into subgroups, and entrusting each of them with an educational device, allows for better management of the situation.

Fifth challenge: adaptation into Teaching and Learning context

GC-5 *Smart classrooms that seamlessly fit into teaching and learning.*

8am: Craft group as learning community.
2pm: Sal as teacher with medical students.
7pm: Sal as student in Greek classroom

Teaching and learning is an educational setting environment of instructors who providing content, objectives, and goals; and learners whom receiving knowledge, performance, and produce outcomes. It's necessary to implement human centered systems capable of: adapting to the educational context, not generating distraction to students, and allowing teachers to focus in their teaching role. Before deploying a smart classroom, we need to analyze the context and implement the right model and features that can fit perfectly to it. the system must be able to ensure proper class orchestration, and smoothly handle a high number of users.

Sixth challenge: metaresearch for performance analysis

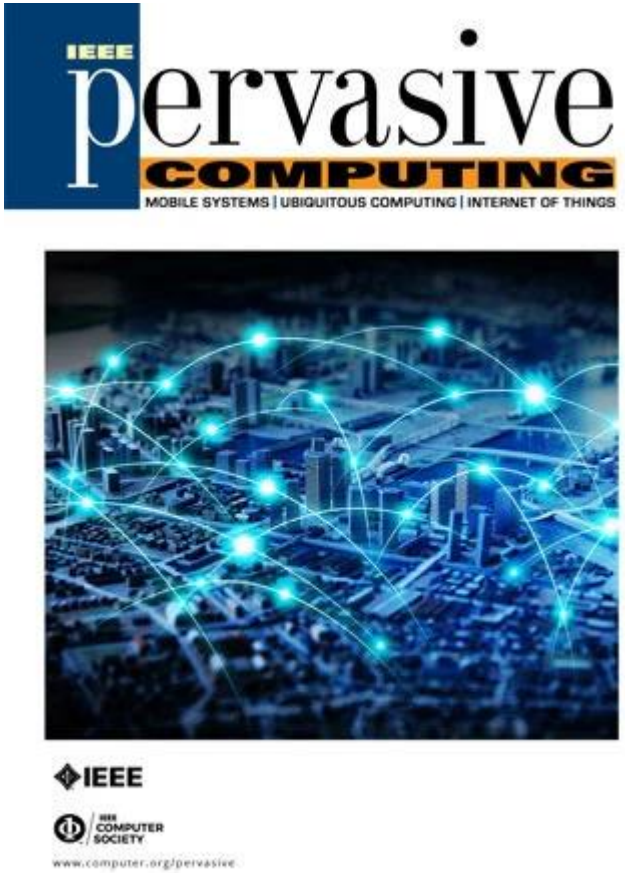
GC-6 *Meta-research to understand when technology really supports learning.*

Sal may consent to release of her data from the mind-wandering app.

Meta-research is the study of research itself: its methods, reporting, reproducibility, evaluation, and incentives. Metasearch is one of the most appropriate tools that can provide us with all the most useful information about the performance of the pervasive educational model. Through this technique it will be possible to test a model in different educational settings, evaluate its progress and adapt it to the most effective one.

CONCLUSION

Learning technologies are undergoing very rapid growth, but many burdens such as distraction and misuse of sensor remain Pervasive computing can completely transform education by ensuring a more effective and, above all, continuous experience along all phases of our daily lives, and by solving various problems such as sitting too much in front of a screen. Pervasive education will ensure increasingly effective learning data exploitation processes to enhance the learning experience, and a variety of human-centered features created available for user well-being-immersion, augmented reality, personalized interfaces



THANKS FOR YOUR ATTENTION