Connecting Communities of Learners
across Continents:
The ShanghAI Lectures

Fabio Bonsignorio
Heron Robots, Genova, Italy
Institute of Biorobotics, Scuola Superiore S. Anna, Pisa, Italy
RoboticsLab, University Carlos III of Madrid, Madrid, Spain
Email: fabio.bonsignorio@heronrobots.com

Nathan Labhart
AI Lab
University of Zurich
Zurich, Switzerland
Email: labhart@ifi.uzh.ch

Christopher Lueg
Computing and Information Systems
University of Tasmania
Hobart, Australia
Email: cplueg@gmail.com

Rolf Pfeifer
AI Lab
University of Zurich
Zurich, Switzerland
Email: pfeifer@ifi.uzh.ch

Abstract—It is widely recognized that knowledge sharing and learning are most effective when occurring in an appropriate and supportive context. As a consequence when designing an educational process the context has to be carefully considered. Implementing “situated learning” is straightforward in traditional apprenticeship models that inspired the communities of practice model, and the centuries-old university model, but poses a formidable challenge when knowledge and associated practices are to be shared with large numbers of students as it is the case in most contemporary, demand-driven universities and even more in MOOCs. The traditional, and well tested, face-to-face teaching model that is in place does not scale even if videoconferencing is utilized to include students at remote locations. A few years ago, MOOCs were presented as a viable “solution”, but while participant numbers remain impressive, experiences also suggest that the learning experience does not scale as easily. In this paper we discuss an alternative knowledge sharing and learning model, the ShanghAI Lectures (SHAIL) developed at the University of Zurich, Switzerland in response to the need of making top quality higher education available to a worldwide audience. SHAIL combines some of the strongest aspects of traditional face-to-face teaching, but also allows lecturing from and to a community which is globally distributed. Findings from delivering the ShanghAI Lectures annually over five consecutive years to up to twenty universities from across the globe (North America, Africa, Europe, Asia, Oceania) suggest that SHAIL is a promising way to address “global teaching”, but there are also challenges to be addressed such as: finding a common base with respect to university requirements, student goals and expectations, teaching styles, and of course the actual technologies used.

Keywords—Intercultural Education; Higher Education; MOOC; Multimedia; Videoconferencing

I. INTRODUCTION

In the recent past the growing importance attributed to IP (Intellectual Property) management by many Higher Education institutions and the steady increase of tuition fees in both private and state-owned universities have by contrast emphasized the need to guarantee both the free circulation of research findings and the availability of high-level research and education to potentially anyone (or at least to those with the required talents or skills), independently of their economic condition and geographical location.

On the one hand this has led to the “Open Access” and “Open Source” movements, exemplified by the wide adoption of the Creative Commons licensing schemes; on the other hand, thanks to new technical possibilities that come with the internet (or, in general, telecommunication technologies), this has favored the creation of several online repositories for educational resources. An early example is MIT OpenCourseWare, [25], an online repository of lectures and teaching materials originating from regular courses held at MIT; another example are the popular small course videos on various topics provided by Khan Academy, [15].

At the same time, the usage of Learning Management Systems (LMS) has spread, in particular Moodle, [24], which is open source, but also the proprietary Blackboard, [4], or ad hoc solutions like the “Aula Global” (Global Classroom) of the University Carlos III, which integrates Moodle into a customized application. LMS allow course administrators to publish courses, share slides and other materials, distribute and collect homework, manage grades, exams, etc. In most cases, LMS are only accessible to students who enrolled in the university course and paid their tuition fees.

We tend to forget that distance learning started as early as in the late 19th century, based on postal mail. As communication technologies developed, courses were taught by radio broadcasting and television. Nowadays the internet and its growing ubiquity allow an even cheaper and much more flexible approach to content sharing.

The acronym MOOC (Massive Open Online Course) was coined in 2008 by David Cormier, then professor at the University of Prince Edward Island in Canada and
by Bryan Alexander, then Senior Research Fellow of the National Institute for Technology in Liberal Education, in Texas, USA. A MOOC usually includes a set of video-recorded lectures that are cut up in segments of just a few minutes and interspersed by quizzes that give students the chance to check their “learning progress”. The diffusion of the MOOC model happened very quickly, especially since the “AI Class” taught by Sebastian Thrun and Peter Norvig at Stanford University in fall 2011, where about 160’000 students registered. The New York Times dubbed the year 2012 as the “Year of the MOOC”.

Following the success of the Stanford University course and subsequent media interest, [26], [17], [18], Thrun founded the for-profit company Udacity, [37], with the initial aim of “disrupting” the world of higher education. As Thrun himself pointed out recently, results were mixed [36]; nevertheless, there has been an explosion of courses on several platforms, the most well-known are Coursera [5], MITx, and edX [10].

While MOOCs often impress with huge numbers of registered students, [23], [34], only a small fraction of these actually complete a course, [16], [3], [34]. Critics also argue that MOOCs should not be considered as an alternative to “traditional, residential” universities and underline the fact that from the medieval beginnings, intercultural and multicultural community building have maybe been the greatest benefit coming from brick-and-mortar universities, see for example [8].

Compared to traditional lectures that are held live in the lecture hall, in a MOOC, there is little possible interaction between the professor and the students. Moreover, there is some evidence that students do not experience the same “sense of community” if they are not attending the lecture together, but follow a MOOC individually, asynchronously, and geographically dispersed, see for example [7], [20], [21].

In this paper we propose an alternative way of making high-level education available to a global audience. Since 2009 the Artificial Intelligence Laboratory of the University of Zurich, Switzerland has been organizing a globally distributed lecture series called “ShanghAI Lectures” (SHAIL) that is held every winter term via videoconference among 12 to 20 universities, most of which have become regular participants. The base lecture series, an introduction to natural and artificial forms of intelligence with a focus on the concept of “embodiment” (based on the book “How the Body Shapes the Way We Think” by Rolf Pfeifer and Josh Bongard [29]), is complemented by guest lectures that demonstrate the breadth of the research area, reaching from philosophical treatments to concrete engineering applications. Students are assigned theoretical and practical group tasks such as speculating about a robot’s “goals” based on observation, conducting experiments in a robot simulator, or constructing a simple robot that has to demonstrate the principles discussed during the lectures. The project website serves as a communication platform for students and teaching assistants and provides access to recordings of all lectures.

In 2013 the SHAIL have extended their scope and under the coordination of one of the authors of this paper, F. Bonisignor, the base lecture has been distributed among several teachers and universities, i.e., Angelo Cangelosi (University of Plymouth), Verena Hafner (Humboldt University), Cecilia Laschi and Matteo Cianchetti (Scuola Superiore S. Anna), while still being substantially based on the ideas summarized in [29].

While conceptually very different from mainstream MOOCs, and maybe more similar to what someone calls a ‘network-MOOC’, the SHAIL also represent a way of leveraging state-of-the-art telecommunication technologies to significantly improve higher education. This paper discusses the opportunities and challenges of the SHAIL approach. In the following section we describe in more details the SHAIL’s goals and organization, in section III we summarize their “history” so far, in section IV we analyze the lecture format from a pedagogical stand point, and in section V we briefly discuss the open challenges and our future plans.

II. GOALS AND ORGANIZATION

The SHAIL project started with a number of objectives, some of which went significantly beyond those of a mainstream MOOC, and continues to expand its objectives by incorporating the needs of the participating institutions:

- Building a community: As the embodied cognition scientific community is still an emerging one, the SHAIL provide a possibility to expose students to this research field early in their academic career and to allow the researchers to present the state of the art in the field to a worldwide audience
- Reducing the education divide: making education and knowledge on cutting-edge scientific topics accessible to everyone independently of economical resources and geographical location (there is no fee for participating in the lectures, and all recordings are made available to the general public for free)
- Experimenting with novel methods of knowledge transfer: the SHAIL constantly evolve by incorporating novel educational concepts and technological developments
- Transforming the challenges of a multi-cultural and interdisciplinary learning context into opportunities: students not only learn about embodied intelligence but also get exposed to different work styles and are part of an international community, which may be helpful in their later careers
- Bringing global higher education teaching to a new level by exploiting telecommunication and telepresence technologies

The lectures and guest presentations are held via video-conference, currently using the H.323 protocol in standard definition quality to keep the entrance barrier low (this may change in the future, as high definition videoconferencing equipment becomes more popular). The recordings are published on the SHAIL website, [31]. To simplify the organization and to make the lecture series more attractive
to students, exercises are not mandatory; however, optional group projects are offered to students seeking a “certificate of achievement”. While the SHAIL website offers communication functions such as messaging, forums, and live chat, students are free to use the communication tools of their choice (Skype, 3-D environments such as Second Life, e-mail, etc.).

The lectures, 2-3 hours a week in the same day, take place usually on Thursdays from 9:30 CET. This implies that the lectures are in the morning for European students and in the afternoon or evening for students from Asia, Oceania. For lecturers and students from the Americas, they are unfortunately in the middle of the night.

To participate in these interactive lectures, students have to physically come to the lecture halls, which on the one hand gives the lecture a certain “value” (e.g., it requires some effort by the students to participate) and on the other hand contributes to a sense of presence, as the participants are not “isolated” but attending the course together with their peers.

A screenshot of what is displayed on the videoconference screens is given in Fig. 1. For practical reasons in a typical lecture room setup we use two separate screens: one for the videoconference and one for the slides, as you can see in Fig. 3. Although several lecture room setups, of different complexities, are possible, in an optimal room it is advisable to have two manually operated videocameras, one following the lecturer and one following the students. The local infrastructure in each participating lecture hall is still quite elaborate, see for example Fig. 5, but technological progress will reduce the overall complexity in the near future.

Every week, one or more speakers – usually high-profile researchers from the field of Artificial Intelligence and Robotics, but also from Neurosciences, System and Synthetic Biology, and Philosophy – are invited to give a ‘guest lecture’ on the topic of natural and artificial intelligence, followed from a Q&A session. Since 2013 the lectures are also streamed live on the internet so that students who cannot attend at one of the 12 to 20 “brick and mortar” universities still have a (somewhat limited) possibility to interact with the lectures, by using a question board, Skype, or Google Hangouts. This is different from a standard MOOC approach where there is no live interaction with the presenters during the class.

The students can volunteer to take a “Kōan” challenge. In the SHAIL context a Kōan ([32]) is a project to answer a challenge designed to improve the understanding of the principles presented and discussed in the lectures. This involves to develop a simulator on Webots or Ludobots ([39], [19]) demonstrating the theoretical principles implicit in the Kōans. Kōans are deliberately challenging and fuzzily defined. An example of a Kōan is given in Fig. 4.

Groups are typically designed to be multicultural in the sense that they involve students from different universities or locations.

In 2013 about 150 students registered for the SHAIL, about 50 of which took on the challenge of participating in the Kōans. The resulting 12 Kōan groups presented their projects at the end of the semester in January 2014 and received their “certificates of achievement” (the remaining students received “certificates of attendance”). Many other students not affiliated with one of the regularly participating universities participated through the streaming on a personal basis, in a similar way to a MOOC, but with the possibility of live interaction.

Apart from these certificates and the Kōans, it is up to each participating university to evaluate their students and to issue credit points – at many universities, the SHAIL yield 6 ECTS points ([9]) – or other forms of certification. The participating universities, with a consistent number of them joining year over year, are spread over the world, mainly in Europe, Asia and Oceania, for time zone reasons (as mentioned above). Some of the guest lectures are from US institutions, and we also have a significant number of accesses on the online repository from the Americas, besides those from the rest of the world. As an example, in the frame below you will find the list of participant universities (partner sites which participated on a weekly basis and or hosted one or more lectures of the main lecture thread) and guest lecture sites in 2013 edition, from which guest lectures were given.

Partner sites in 2013

- Budapest University of Technology and Economy, Hungary
- University Carlos III of Madrid, Spain
- Chiba University, Japan
- Humboldt University Berlin, Germany
- Lodz University of Technology, Poland
- New York University Abu Dhabi, UAE
- Northwestern Polytechnical University, Xian, China

Figure 1. Standard layout of the videoconference screens – main speaker in a big panel, other sites on smaller panels.

1 According to Wikipedia, “A Kōan is a story, dialogue, question, or statement, which is used in Zen-practice to provoke the ‘great doubt’, and test a student’s progress in Zen practice.”
The SHAIL are unlike other classes on Artificial Intelligence also regarding their content. Most AI courses, like the Stanford AI Class mentioned above, deal with “traditional AI” (machine learning, symbol manipulation, problem solving, etc.), which is sometimes also referred to as GOFAI (Good Old-Fashioned Artificial Intelligence). In the GOFAI school of thinking, intelligence is viewed as essentially (symbolic) information processing that takes place in the brain.

The SHAIL, in contrast, provide a more holistic perspective by introducing the concept of Cognitive and Embodied Intelligence, where it is recognized that intelligence results from the interplay of brain, body, and environment. From this point of view, intelligence is seen as a property of an entire organism and the study of natural forms of intelligence becomes extremely relevant, thus extending the scope to neuroscience and system and synthetic biology. The widespread implications of this view range from engineering to philosophical and social problems and they affect the very perception of ourselves and our role in the world. Examples and illustrations are taken from humans, animals, and engineering (robotics in particular) and demonstrate that things can always be seen differently from what we would normally expect. Using the method of “understanding by building”, the lectures provide a set of design principles that on the one hand enable a better understanding of biological systems, and on the other hand provide heuristics for how to design artificial systems, in particular robots. The lectures deal, among other topics, with the notions of time scales, self-organization and emergence, complex dynamical systems, information theory, biomechanics, material science, etc. The theoretical ideas are illustrated with many examples and case studies from academia and the private sector (e.g., by including guest presentations from companies that employ the concepts of cognitive, embodied intelligence research).

III. HISTORY

The SHAIL are a work-in-progress experiment in higher education. Every year new approaches, contents, and tools are introduced and some previous ones are discarded. A cornerstone is the interactivity, i.e., the fact that the audience always has the possibility to directly ask questions to the lecturers, or to contribute to a discussion “live”. Intentionally we do not depart too much from the well tested higher education model represented by universities.

2009: The beginnings To accompany the publication of the Chinese translation of the textbook [29], which was done by a team at Shanghai Jiao Tong University (SJTU), the initial lecture series was hosted mostly at SJTU, where a regular lecture room was set up with all the necessary equipment (cameras, lights, computers, screens, video and audio mixers, microphones, etc.) to become a “broadcast studio”. The videoconference and recording were managed collaboratively at the University of Zurich and at ETH Zurich using the infrastructure and services provided by SWITCH, the Swiss Education and Research Network. As the videoconference spanned several continents – North America, Europe, Africa, Asia, Australia – the collaboration of national research and education networks (NRENs) and continent-wide backbones such as SWITCH, DANTE/GÉANT, and CERNET was necessary to ensure enough bandwidth, an issue that today is less constraining.

In addition to being an academic lecture series, the project originally also served as a research platform on virtual team behavior in an international setting [12]. A 3-D environment called “UNIworld” was established where exercises were to be solved by groups composed of students from different universities. UNIworld was based on the open source “Wonderland” framework originally developed by Sun Microsystems.

2010: Focus on interactivity To further propagate the 3-D environment, some of the weekly classes were not held via videoconference but completely in UNIworld, i.e., lecturers and students all participated as avatars. These so-called “Discussion Sessions” were meant to enable even more direct interaction among the participants, as everyone was “in the same room”, not separated by video screens. While it was possible to stimulate some interactivity – e.g., students could anonymously write their answers on sticky
notes, instead of having to talk into a microphone and being captured on camera (Figure 2), or they could “vote with their feet” (there were two “answer slides” positioned next to each other, and students could move their avatar to the one slide they agreed to) – the 3-D environment proved not very popular among the students, mostly because of technical issues and rendering limitations, but also because exercises could be solved in a better way offline.

**2011: Focus on web community** For the next installment of SHAIL, the 3-D environment UNIworld was suspended and replaced by two other components: On the one hand, thanks to a collaboration with Cyberbotics Ltd. in Switzerland, all registered students got access to the professional “Webots” robot simulator that is being used in some of the exercises. On the other, the website was completely rebuilt to offer more tools for communication and collaboration with the goal to foster the online community: In addition to “social network” features similar to Facebook (such as friendships, private messages, real-time chat, and discussion groups with file uploads), the new website also serves as an LMS by providing administrative tools for managing users (students, teaching assistants, lecturers), assignments and exercise groups, and the repository of recorded lectures. It was also in 2011 when the Twitter handle @shanghailecture was established, though its function was primarily to announce the availability of new recorded lectures.

**2012: Physical interactivity** After having lectured about the importance of “embodiment” for two years, in 2012 finally hands-on robot competitions were introduced. Some of the participating universities already had one or more NAO robots (a commercial humanoid platform by Aldebaran Robotics) that could be used for the first competition. For the second one, each university received an “EmbedIT” package, a kit developed by a PhD candidate at the AI Lab in Zurich [2] which perfectly demonstrates some of the essential implications of the “embodied” approach.

**2013: Broadening the spectrum** In 2013 most lectures were held from a new main site (Madrid), and the base series was distributed among several lecturers, thus expanding the scope of the SHAIL. In addition to being recorded, all lectures were also streamed live for anyone on the internet to follow, published on YouTube, and “external feedback” was enabled via social media (Twitter and Facebook). Instead of the exercises in previous years, “Kōans” were introduced. After two years without one, a 3-D environment was offered again – this time using the commercial “Second Life” framework ([33]).

In the five years since 2009 there have been about 50 universities involved in one way or other, almost 200 guest lectures published on the lecture repository – about 100 hours of recordings –, and well over 1000 students participating (only those who registered on the website can be counted), but we have heard of several students who followed the lectures without registration – especially in 2013 there were dozens of students participating only by watching the live stream). Yearly attendance have been fluctuating in between 150 and 400 students. We believe this is a proper class size, perhaps already too big, if we want a real involvement of the students. In our opinion, courses delivered to mass audiences can be a very useful integration to more personalized ones and maybe a solution of last resort when other solutions are not viable for economical reasons, but they cannot substitute face-to-face interaction among teachers and learners. The participation in the virtual world activities have been significantly lower (an average 50 people when we had lectures). We are seeking in the next editions a better integration of the virtual world activities (giving them a more critical role and testing more advanced rendering platforms). In 2013 about one third of the registered students were involved in the koans. We are studying how to increase the percentage of students participating in the Kōans, although it seems acceptable that a part of the students see a sufficient benefit from a more “classical”, and perhaps more “passive”, involvement.

**IV. Pedagogical considerations**

The mainstream MOOCs approach, while enabling a massive distribution of the teaching materials, including the video recordings of the lectures, shares many of the limitations of the generalist television broadcasting, first of all the limited interaction between the teacher and the learner and an equally, or more, limited interaction among the learners. Different kinds of teacher–student interaction are possible. The MOOC model implements a “star” configuration with the lecturer in the center, which does not seem to be the best approach to teaching – not only according to the personal experience of many professors

Studies such as those by Orletti [27], [28], [11] on the limits of the “institutional asymmetric speech” or the specific semiotic aspects of the intercultural linguistic communication (exacerbated by the usage of a non-native
language [38]), as well as those on the social action as the framework of learning process [22] show that the learning process in an intercultural context is a process of (iterative) conversational construction of the identity through the social interaction.

From a purely experiential and historical point of view it is difficult to object to Eco [8] when he underlines that from the medieval origins of the “University” institution (Bologna was founded in 1088 AD) the multicultural interaction into a multicultural community of researchers, teachers and learners has been the Universities’ main social value and distinctive characteristic with respect to other, older and newer, education models. The SHAIL model expands this characteristic by exploiting telecommunication technologies to create a "global hall" where theoretical research, teaching and learning simultaneously occur. The many guest lectures and the lectures hosted from different universities, provide global cultural and scientific diversity to the teaching. This richness of interaction and content is something simply not possible in a traditional residential university. In the “standard” MOOC model the generalist TV broadcasting model is mimicked and technology is exploited to reach a mass audience (which, in a physical setting, would perhaps only be possible by using a large sports stadium as “lecture hall”) with the obvious limitations coming from the insufficient teachers/students ratio. In the SHAIL model technology is exploited to achieve diversity and worldwide distribution, providing more quality to the learning experience than possible in residential universities to an audience which is numerically similar to that of usual courses, while keeping costs as low as possible.

From an educational perspective, the SHAIL contribute to a better understanding of the technical and social mechanisms that enable learning in an intercultural environment. For example, in contrast to MOOCs, the SHAIL are held live and students have the possibility to directly interact with the lecturers, conveying a “sense of presence” more similar to a brick-and-mortar classroom situation. In addition, in the videoconference not only the lecturer is shown but also a number of the participating sites, so students see that they are connected to their peers all over the world. This builds a sense of community and, in the practice of interaction in the “global lecture hall” and while working together on the Kōans, a real community.

V. DISCUSSION AND FUTURE WORK

The concepts of a “global lecture hall” and the choice of the embodied approach to not only artificial but also natural intelligence give a special relevance to the ShanghAI Lectures. The “global lecture hall” model, with the live streaming of the lectures and the repository of recorded presentations, offers mass distribution facilities similar to MOOCs while at the same time retaining the advantages of a more traditional face-to-face setting at the participating universities. Their specific advantage is the potential to building a multicultural community of learners, teachers and researchers analogous to that of a global top tier university, but with a level of geographical distribution which was not possible in the past.

On the other hand, the content of the lectures, on the very edge of several very dynamic research fields, from AI and Robotics to Neurosciences and Synthetic Biology, shows to the students a living and always evolving landscape, not only of widely accepted models, like in many traditional courses, but also of open problems, in the solution of which they can be engaged as part of the community. The Kōans and the open ended content push the student to a more critical approach to their learning. We believe this critical attitude is a characteristic aspect of higher education which is somehow lost in mainstream MOOCs.

We believe the SHAIL model could provide a good basis for the “University of the future”, as SHAIL exploits novel developments in educational technology while preserving the centuries-old, proven concepts in education, and significantly expand the multicultural dimensions of the community and the maturation of the critical thinking attitude of the students.
A. Open issues and future developments

As the lectures are technologically mediated it should be investigated how a rich multimedia distributed ICT platform could be exploited to change the lecture model itself, towards a cooperative interactive multimedia presentation. We will also have to achieve a better integration of the 3D virtual world participation into the main thread of the lectures. By the sessions dedicated to the Köan’s presentation we have already integrated modules which are perhaps taking cues from the “inverted classroom” approaches. In an “inverted” or “flipped” classroom, the students use recorded lectures for preparation and then come to the lecture halls to discuss details and questions in a more seminar-style manner with the lecturers. In our approach the student have “standard lectures” during which they interact with the lecturers (more than one), are stimulated to check the lectures stored in the lecture repository and then have to show their own findings in seminar style presentations where also their peers participate. We will also need to have better metrics of the achievement of our objectives.

The level of interaction may also be increased by providing lecturers and students with basic training on how to “perform” within the “global lecture hall” (be it a TV talk show type setting or a 3-D environment). In the videoconference the sites are usually shown in more or less static views of the entire classroom. By dynamically zooming in on whichever student is asking a question a more engaging sense of telepresence might be achieved (though some students do not feel at ease when a camera is pointed directly at them). Moreover the other sites are seen through a 2D Videoscreen, we should find ways to make more engaging the sense of telepresence, for example by a dynamic usage of zoom in the video and a quicker possibility from students to attract the attention of the lecturer or of whom is currently speaking. The physical and virtual setting of the global room will continue to evolve as new technical possibilities will raise.

Social network platforms should include those popular in some great countries, such as in China Weibo or Renren. The centralized question board on the ShanghAI website will need to be kept for consistency reasons (maybe providing a gateway among the different social networks. Finally, HD videoconferencing is now possible, with less costs and more quality than by the H.323 protocol, [1], [40], through web based Video-over-ip solutions like those provided by Google+ Hangouts and Adobe Connect, in the future we will migrate to a similar platform. A lot has been done, a lot has still to be done.

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