FirstBridge Under Construction: Me and My Avatar

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Abstract

The main goal of this article is to give an overview of our experience of designing and teaching the first-semester learning community "FirstBridge" set of courses at The American University in Paris (AUP) - *Social Robotics* and *Self and the Automated Other* - from a constructionist point of view. We would like to go beyond the typical course assessment and offer our reflections on what and how the students (and the professors) have been learning, and, on a meta-level, what they think they have been learning.

One of the key elements of Piaget's genetic epistemology is that cognitive development occurs in stages gradually moving from concrete "here and now" sensory-motor experiences via concrete operations towards internalized abstract, formal operations (Piaget, 2000). In some way, this abstract high-level knowledge is seen as "superior" to the knowledge acquired in physical interactions. However, as Ackerman (1996) observes: "[A]n increasing number of psychologists and cognitive scientists have adopted the view that knowledge is essentially situated and thus should not be divorced from the contexts in which it is constructed and actualized. […] It challenges the prevalent view among developmentalists (such as Piaget and Kohlberg) that removed, analytical modes of thought are necessarily more advanced forms of cognitive functioning. It questions the notion that cognitive growth consists in an uni-directional progression from concrete to abstract, from fusion to separation […]." (*emphasis added*)

What Piaget neglected, in some sense, is that the cognitive development of adults continues further to levels of deeper understanding (c.f. Campbell and Bickhard, 1993) and it is virtually always based on physical operations that transform internal/abstract ideas into tangible and sharable objects. These created objects allow for a new way of looking at one's internal constructs and thus enable one to take different perspectives as well as undertake different types of manipulations. Most significantly, the cognitive loop is closed via the social space: the created objects are visible and manipulable by others. With this in mind, we have tried to create a FirstBridge that enables assimilation and accommodation within the social context of a "learning community". Students can collectively see and discuss what they constructed, check what they learned or what skills they acquired, and then extend and transfer these skills to different contexts. The structure of both courses and their interaction is outlined.

This FirstBridge has had a positive impact on getting students interested in ICT, mathematics, and natural sciences in general, as revealed by increased number of ICT majors as well as students' testimonials during one-on-one interviews at the end of the semester. We intend to track all students that took this FirstBridge until their graduation and see the long term effects with respect to students who have taken different FirstBridge courses.

Keywords

Mind, modelling, analogy, scale models, Lego NXT Mindstorms, Alice programming environment

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The paper opens with a brief introduction about the concept of FirstBridge at AUP. This section is followed by a short summary of the place and role of constructionism within our teaching/learning philosophies. In the next section we highlight a few of the constructionist dimensions within the two courses. We then present some examples of the student projects, as well as their feedback collected via anonymous course evaluation (at the end of the semester) and via informal one-on-one interviews.

In the conclusion, we summarize and evaluate our application of constructionist methodology in the classroom, highlight the successes and attempt to address the observed shortcomings.

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Introduction

The first author of this paper has an extensive research experience in the domain of artificial intelligence and particularly in the field of developmental robotics (e.g. Stojanov et al 1997; Stojanov, 2001; Stojanov et al 2006). The author's research focused on the application of Jean Piaget's insights from developmental psychology to the construction of artificial intelligent agents, in order to gain insight into the fundamental processes of learning and cognitive development in artificial and natural systems. The opportunity to teach a FirstBridge course immediately resonated with this past experience as the "learning community model" provided a pedagogical challenge where we could apply these insights to a classroom context. In the following subsections we briefly introduce the concept of FirstBridge at AUP and then the philosophy of the authors' particular FirstBridge: Me and My Avatar.

What is FirstBridge at AUP?

Our experiments in constructivist pedagogy occur within a specially designed General Education curricular structure named "FirstBridge". FirstBridge is a collaborative "Learning Community" for first-semester freshman at The American University of Paris and is comprised of two courses

from different disciplines that are thematically linked and that take different disciplinary approaches to diverse issues such as global warming, artificial intelligence, human rights, civil conflict, visual thinking, food, to name but a few of them. The reader can find an excellent description of the general goals of the FirstBridge concept in (Clayson, 2008).

In our case, we have created and combined two distinct courses for our "Me and My Avatar" Learning Community: one from Computer Science, CS 221 Social Robotics, and one course from the Humanities, CL 100, that draws on Philosophy of Mind, Comparative Literature, and Global Communications and Media Studies.

One of the curricular specifications of the FirstBridge program was to introduce first semester students to complex, high-level problems and to devise task-based lesson plans. One of the primary learning objectives is for students to explore creative problem-solving within an interdisciplinary framework while sharpening the fundamental academic skills of critical reading, writing, and thinking. The students meet twice a week for each course plus one period per week for and interdisciplinary Reflective Seminar where the connections between the two courses are explored. The Reflective Seminar is also the place where the students, with both professors, try to "step-out" and reflect about what they have been learning, thus "constructing a public entity" out of the knowledge and the skills.

The philosophy behind the Me and My Avatar FirstBridge

The pedagogical approach of this FirstBridge, partially based on the insights gained during our research in the cognitive development of artificial and natural system, is essentially constructionist. Although we adopt the general big picture about the development of knowledge via the Piagetian processes of assimilation and accommodation we strongly believe that physical and social interactions in adult cognitive development play a far bigger role than suggested by Piaget.

One of the key elements of Piaget's genetic epistemology is that cognitive development occurs in stages gradually moving from concrete "here and now" sensory-motor experiences via concrete operations towards internalized abstract, formal operations (Piaget, 2000). In some way, this abstract high-level knowledge is seen as "superior" to the knowledge acquired in physical interactions. However, as Ackerman (1996) observes:

"[A]n increasing number of psychologists and cognitive scientists have adopted the view that knowledge is essentially situated and thus should not be divorced from the contexts in which it is constructed and actualized. […] It challenges the prevalent view among developmentalists (such as Piaget and Kohlberg) that removed, analytical modes of thought are necessarily more advanced forms of cognitive functioning. It questions the notion that cognitive growth consists in an uni-directional progression from concrete to abstract, from fusion to separation […]." (*emphasis added*)

What Piaget neglected, in some sense, is that the cognitive development of adults continues further to levels of deeper understanding (c.f. Campbell and Bickhard, 1993) and it is virtually always based on physical operations that transform internal/abstract ideas into tangible and sharable objects. These created objects allow for a new way of looking at one's internal constructs and thus enable one to take different perspectives as well as undertake different types of manipulations. Most significantly, the cognitive loop is closed via the social space: the created objects are visible and manipulable by others; a fact that gives the person who created them the possibility to gain distance and to relate to these objects from a different perspective. In addition, our minds opportunistically extend themselves via these artefacts in the sense suggested by Andy Clark (e.g. Clark, 2004).

With this in mind, we have tried to create a FirstBridge that enables assimilation and accommodation within the social context of a "learning community". We start by identifying a concept/a situation/an idea and then devote a significant portion of class time to building **models**

of those concepts (using different media: from physical scale models to virtual worlds). The objective behind this is to create object-referenced learning opportunities for further group discussion and reflection. Students can collectively see and discuss what they constructed, check what they learned or what skills they acquired, and then extend and transfer these skills to different contexts.

To quote Ackerman (1996) again:

"People cannot learn from their experience as long as they are entirely immersed in it. There comes a time when they need to step back, and reconsider what has happened to them from a distance. They take on the role of an external observer, or critic, and they revisit their experience "as if" it was not theirs. They describe it to themselves and others, and in so doing, they make it tangible and shareable." (*emphasis added*)

Ackerman (1996) calls this movement of immersion and distancing a "dive-in and step-out" process. When developing our FirstBridge, one of our main considerations towards the application of a constructionist learning approach was to create a series of controlled learning experiences where our students could "dive-in and step-out".

The Practice of Me and My Avatar

As mentioned above, the notion of a "model" is crucial for this FirstBridge. Here, it is used to cover the full gamut from physical scale models, to stories as a particular way of describing one's experience, to metaphors as models of one situation in terms of another, to scientific theories as models of particular part of the world. We have designed a series of assignments where the students build models of increasing complexity.

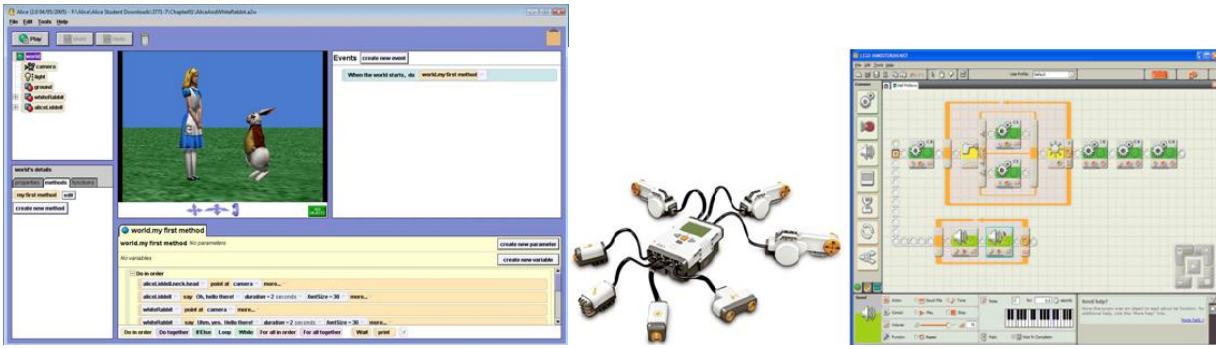
In Social Robotics, the **first assignment** in the series is to **build a scale model of the ground floor** of the University building. The only criterion, students are told, is that the scale model should be recognizable as the ground floor of the University building. Below (Figure 1) are four examples of these scale models.

Figure 1. Samples of students' projects for the assignment "Build a scale model of a University ground floor level"

When these models are discussed in class, we point out to our students how, for the very same building, each of us constructs his or hers own model of the building: stressing some parts while completely omitting others (e.g. the chess board like tile floors, the walls and the windows).

These processes, alongside with embellishment, simplification, and addition (as elaborated by Goodman, 1978) are universal to all modelling activities. Goodman's 1978 book *Ways of Worldmaking* is first in the series of assigned readings, and the students often recognize the above mentioned processes during their work on this first assignment. This is discussed during one of the first reflective seminars.

The second **assignment is to build a virtual model of the same ground floor** as in the previous assignment using the Alice programming environment. Alice is a friendly 3D programming environment with an intuitive drag-and-drop interface (Figure 2a). In essence, it is a fully-fledged Java based programming language that allows students to learn the basics of object oriented programming. In the FirstBridge context, our main goal is not to teach the basics of OOP but to give students a tool for creating models, in this case, appealing 3D movies, or virtual worlds.



a) b)

Figure 2. a) A screenshot of the Alice programming environment (more info on Alice available at alice.org; b) Lego NXT kit (programmable brick, sensors and motors) and the visual programming environment (more info available at mindstorms.lego.com)

By drawing analogies with the previous assignment, students easily adopt the language of *object* oriented design: virtual objects are similar to the physical ones and virtual environment makes it easier to create and manipulate them. While talking about Alice programs, we adopt the "programs as movies" metaphor suggested by Alice creators (Dann, Cooper, Pausch, 2005; see also Adams, 2006). After this first, fairly simple virtual model, we move further on building quite complex programs: from short movies to highly interactive games. This is done gradually by introducing students to methods and functions as ways to change objects' behaviours and to interact with them.

Finally, **the third assignment is to build and program a given behaviour for a Lego NXT Mindstorms kit robot** (Figure 2b)**.** Robots, in this context, are more complex models that consist of physical parts, and the program that controls the behaviour of the robot (or its virtual part).

After the introductory tutorial, we move on and construct "intelligent" mobile robots inspired by Braitenberg's vehicles (Braitenberg, 1982). Again, students find the transfer of skills from the Alice environment very natural and helpful in understanding the new medium.

As it can be seen, differences among these models vary according to different dimensions: physical or virtual, static or interactive. From the simplest one: physical and static to the most complex ones that are partly physical partly virtual *and* interactive.

Within the Humanities-based companion course, *Self and the Automated Other*, the challenge is to overcome the 'instructionist' (Fischer et al., 2007) pedagogical tradition and its formal 'idealism' by creating constructionist assignment sequences that become increasingly 'materialist'. The course begins with an exploration of the concept of "concepts", which students

are encouraged to sketch, draw, figure and 'model' in order to apprehend "concepts" not as abstract intangibles, but as concrete, mental "building blocks" with various affordances.

Course readings are presented less as ideas and theories that are to be learned by rote and placed into the students' "exam-ready retrieval systems" than as guides to and examples of various constructionist approaches to modelling the self and consciousness, which have contributed to the development of a disciplinary history. For example, while reading René Descartes' *Meditations* students re-perform Descartes' famous experiment with wax (but this time with French chocolates) in order to re-construct their own experience-based model of Cartesian rationality. Students use Venn diagramming to model the "mind-body problem" within the history of philosophy of mind; construct maps and timelines to depict the narrative sequences of films such as *Memento* (Christopher Nolan 2008); and eventually produce "full-scale" multimedia models of once-abstract philosophical "concepts" for their final projects.

During the reflective seminars we organize discussions where students are urged to look for connections between the two courses and apply concepts and skills that they acquired in one course to the content of the other course.

Students' final projects have included video performances, paintings, an opera complete with a musical score and recorded songs, blue-tooth controlled Lego robots emulating Braitenberg 'vehicles', etc. In the course, the students move from abstraction toward a collectively-constructed concretization of philosophical and literary 'ideas' and 'concepts'.

The core concept, theme or task that links the two courses is that of 'Modelling', but, as evidenced above, at many different levels: from perceptual phenomena to aesthetic and literary depictions; from commonsense thinking and perception to philosophical reflection and scientific reasoning.

Conclusions and discussions

In the above case study, we have tried to summarize our approach in designing and teaching the FirstBridge Me and My Avatar as a part of the general education requirement of the students at the American University of Paris.

In conclusion, we would like to say something on the student feedback. Overall, as measured by the anonymous evaluations at the end of the semester, student feedback has been positive. At times, we have encountered some resistance at the beginning of the semester but this resistance was mitigated by the end of the first month. This FirstBridge has had a positive impact on getting students interested in ICT, mathematics, and natural sciences in general, as revealed by increased number of ICT majors as well as students' testimonials during one-on-one interviews at the end of the semester. We intend to track all students that took this FirstBridge until their graduation and see the long term effects with respect to students who have taken different FirstBridge courses.

As a general observation, to our knowledge, no one has made the connection so far between Clark's thesis of the extended mind (e.g. Clark, 2004) and Papert's constructionism. We believe that further exploration of this link will enhance our understanding of the crucial mechanisms for knowledge development.

At a meta-level, the exercise of the FirstBridge was an excellent opportunity to "dive-in and step-out" from the immediate experience of teaching a course (in computer science, for example). It has definitely been an enriching experience and we are looking forward to the disequilibrational adaptation. The present paper is a result of this process.

For more samples of student projects please visit ac.aup.fr/gstojanov/CONSTRUCT10

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