UDIGITAL.EDU: ENCOURAGING CREATIVE LEARNING AND CRITICAL THINKING THROUGH INFORMATION AND COMMUNICATION TECHNOLOGIES

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Abstract

The UdiGital.edu project—led by nine multidisciplinary research groups that make UdiGital (a strategic research unit of the University of Girona)—is inspired and supported by the theory of Constructionism, and it combines aspects of Educational Innovation, ICT in Education, and ICT for Development. Specifically, the project aims to study how the ICT–Media technologies known by UdiGital (eg. Robotics and Artificial Intelligence) can help to stimulate the creativity and critical thinking of children and youth. The project has a strong component of science popularization and dissemination of knowledge, and also a component of fostering talent and innovation. However, it goes one step further and aims to study, by means of workshops and activities with children and young people, how ICT-Media technologies can help to build a critical awareness of our environment.

Keywords: ICT, Multimedia, Artificial Intelligence, Robotics, Education, Creativity, Lifelong Learning, Constructionism.

1 INTRODUCTION

UdiGital is a strategic research unit of the University of Girona in the field of ICT-Media. It consists of nine multidisciplinary research groups (6 technological groups, and 3 groups in the field of Humanities, numbering more than 200 people, of whom seventy of them are doctors), and intends to specialize in creating innovation within the field of ICT, and specifically in multimedia.

The UdiGital.edu project has emerged as a joint initiative of the nine research groups that make UdiGital, and with the support of the University of Girona. UdiGital.edu is a physical place in the Narcís Monturiol building of the Science and Technology Park of Girona. It's a place equipped with the latest ICT-Media technologies, conceived and designed so that children, teenagers, adults and seniors can learn by interacting. UdiGital.edu is a place for learning by doing, a place to promote innovation and creativity, a place where visitors can touch and experiment rather than simply looking.

The nine research groups have designed workshops and activities to make university research more accessible to society, through ICT-Media technologies, particularly those in which UdiGital has expertise: Video Games, Robotics, Artificial Intelligence, Computer Vision, Augmented Reality, 3D, etc. The project's objective is not only the communication and dissemination of Science and Technology. It also tries to promote talent and innovation, and it is intended that all the activities will actively promote the critical thinking and the creativity of the people involved.

The whole project turns around the idea that creativity used in a proper way, can become an important tool for Human Development, being the long-term goal the transformation of these children and youth who participate in our workshops and activities into agents of change, creative and innovative in their own communities, and committed to their social reality. This way, they will be able to propose new alternatives to improve their life quality, and to start projects to create wealth in different social environments.

In addition, UdiGital.edu wants to do research on the impact of ICT in education. We are especially interested in studying how the use of the technologies that we know best (eg. Robotics, Artificial intelligence) could be important in the development of key skills for the youth of the XXI century: creativity, critical thinking, team problem solving, and lifelong learning.
2 THEORETICAL FOUNDATIONS

2.1 Constructionism

Constructionism is both a theory of learning and a strategy for education, devised by Seymour Papert [1]. It is inspired by the constructivist theories of psychology and builds on some of the ideas of Jean Piaget [2]. Constructivism asserts that knowledge is not simply transmitted from teacher to student but is actively constructed by the student's mind. Papert's Constructionism goes a step further and defends the theory that human beings construct their knowledge with particular effectiveness when they are involved in the construction (reconstruction) of personally meaningful artifacts, such as a robot, a poem, a sculpture or a computer game.

Undoubtedly, ICTs can be a useful tool for developing constructionist approaches in the classroom. In fact, according to Resnick [3], New Technologies can help students navigate the creative thinking spiral (Fig. 1). In this process, students imagine what they want to do, create their own project, play with their constructions, share their ideas and creations, and reflect on their experiences. And this process leads students to imagine new ideas and new projects.

![Creative Thinking Spiral](image)

Fig. 1 Creative Thinking Spiral [3]

2.2 Robotics and Artificial Intelligence in the classroom

Undoubtedly, when someone today thinks about how to use ICTs to implement constructionist theories in schools, Robotics is one of the first ideas that come to mind. Educational Robotics has the great advantage that it is fun and exciting but also faces students to serious and complex problems, forcing them to think and explore by themselves mathematical, physical and engineering concepts.

Educational robotics is gradually entering the schools of developed countries. Some governments have seen the benefits it provides, and there are some public initiatives to support the introduction of robots in schools. Because of the proximity, we highlight the Enginycat initiative of the Government of Catalonia [4], which aims to promote engineering to young people, through actions such as educational robotics workshops in high schools. An example of robotics workshop for high school students, which is now fully consolidated, is the Underwater Robotics Workshop at the University of Girona [5].

A revealing fact of this ongoing trend of bringing robotics to the schools, is that Google, with its Project $10^8$100 [6], selected as a finalist among more than 150,000 ideas for improving the world, an idea
based on supporting initiatives that promote science and engineering among young people, and it explicitly highlights the importance of introducing robotics in the classroom.

So far, we talked about robotics, and it is now the turn of the Artificial Intelligence (AI). Obviously, building robots is not enough; you also need to program them, and this is where the AI is needed. A pioneer in studying the effects of introducing programming and AI in schools is Seymour Papert, the father of Constructionism.

According to Papert [1], we learn more and faster if we take conscious control of our learning process, and if we articulate and analyze our knowledge. And it seems that programming in schools helps us to do all these things. In fact, Papert goes even one step further and suggests that learning formal languages while being small improves our ability to speak and think about complex problems. And he also suggests that teaching AI to children helps them to think in a more concrete way about their own mental processes. Somehow, introducing AI in the classroom encourages children to become small epistemologists: it allows them to think about how they think, in a way that favors the development of their metacognitive processes.

Programming the robot, in fact, is to teach it to do things, and everyone who has ever taught a class knows that the best way to learn a concept is just trying to explain it. By the time you make the effort to explain the concept, you digest and understand it better. The robots allow us to learn while teaching, because they do not know how to do anything for themselves. For example: How do you learn more about the concept of a circle? Looking at its formula on the blackboard, or programming the robot to draw a circle on a card?

3 RELATED PROJECTS

Our most important reference is the Lifelong Kindergarten research group at MIT Media Lab. They study and design devices and software that help people to continue learning throughout life as they learned in kindergarten: self-learning, trial-error, learning by doing, and so on. A very successful recent example of their work is the Scratch programming language [3].

Also at MIT, and with a similar philosophy, there is the Sea Perch program [7], which connects students and scientists around the world through underwater robotics. The idea is to develop a very simple underwater robot in order to stimulate the enthusiasm of children for Science, Technology and Engineering.

A project of the University of Girona, prior to UdiGital.edu project but very related to it, was the project developed at Shanti Bhavan [8], a rural school in southern India. Several educational robotics workshops were held there, having similar objectives to those pursued in the present project.

Another nearby project that proves the success of such initiatives is the Forum Impulsa of the Prince of Girona Foundation [9], an innovative event with neural network format in which adults, youth and children participate not only through lectures but also through educational robotics workshops and other activities designed to stimulate creativity.

A related project called CAMBODIA-p.r.i.d.e. [10] (Providing Rural Innovative Digital Education) seeks to promote learning through creative exploration. Their digital learning program in a rural area of Cambodia now serves as an innovative “school in a school”, complementing the rudimentary government school system. The school’s innovative approach includes MIT-developed learning programs (e.g., LEGO Mindstorms, Scratch).

Another interesting work is the project of Claudia Urrea [11]. Urrea conducted a project in some rural communities of Costa Rica, to study how the design of robotic devices and the use of other digital technologies can improve student learning, while also can contribute to the improvement of rural community life. The project analyzed the relationships between learning, technology and culture, and studied how to reduce the gap between urban education and rural education. Urrea gives much importance to the participation of the community, and raises the project from the perspective of participatory development.

4 OUR MODEL

One feature that distinguishes our project from other initiatives is that all our workshops are conducted by the same professors and researchers who have conceived and designed the activities. There is
also a coordinator with a technical background, he works for all workshops, managing and coordinating the various initiatives that the 9 research groups are promoting.

Following the philosophy mentioned in section 2, to date we have developed over twenty workshops, with different formats, audiences and topics. We have also established the architecture and structure of the workshops, and the organization, coordination and monitoring of each one of them. Part of the interaction with the audience is done by using web 2.0 tools: blogs, Facebook, and Twitter. The website udigital.udg.edu provides information about the project, a catalog of the workshops, and some interaction tools (Fig. 2).

![Fig. 2 Project website: udigital.udg.edu](image)

Each workshop is completely different, and is driven by one of the 9 research groups, but all the activities share a common structure based on the Creative Thinking Spiral that we mentioned in the introduction.

Right now we have 4 workshops fully consolidated:

- Underwater Robotics Workshop (Fig. 3)
- Rescue Robotics Workshop
- Augmented Automatics Workshop (Fig. 4)
- Introduction to Scratch

Other workshops in the pilot phase are: Scratch+WeDo, Geolocation, Wheelies (self-balancing vehicles) and Augmented Reality.
In a first phase, our scope of action through the workshops (and through the studies and analysis to be conducted) is mainly the province of Girona (Catalonia), but especially the urban area comprising Girona and Salt.

Social commitment and pluralism are two fundamental values in our project. We want all sectors of society benefit from the workshops, and we would like to work specifically with schools with a high rate of immigration and with a high rate of youth at risk of exclusion. If the idea behind the project is that creativity can become an important tool for Human Development, there is no better way to prove it than work in the most disadvantaged areas.
5 CONCLUSIONS

We are at an early stage of the project so it is difficult to highlight results and conclusions. Still, the ratings and the feedback we have received from participants are very positive and encouraging. Proof of this is that many groups are asking us to repeat the experience, and we have also received several requests from teachers who have participated, in order to organize training courses for educators, so they can replicate our workshops in their schools.

We believe that our model differs from others, especially because the multidisciplinary nature of the involved research groups. And we think it is an exportable model to other universities and Science and Technology parks.

REFERENCES