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3D turtle coding activities for Korean primary education

Han Hyuk Cho, Hanik Jo, Cho Hee Lee, Eun Ji Lee and Hye Rim Jeong

The recently revised national curriculum for primary school in Korea inserted constructive activities with "linking cubes" for 6-th grade math class to improve students' spatial abilities. In addition, with the worldwide trend to regard coding education as great important, the Korea Ministry of Education announced that the class for coding be mandatory at primary schools after 2018. However, due to the absence of appropriate expressive systems for the shape of 3D cube stacks and the paucity of coding educational tools for primary school students, the schools will be suffered from a lot of difficulties to teach it.

(As presented in Figure1,) 3D coding activities with the 3D turtle representation system and the 3D printer were designed to present the solution to overcome the hindrance. Moreover, the 3D turtle coding activities are expected to play the role as a bridge between primary schools and middle schools in both mathematics and coding education, which will make the students possible to enhance spatial abilities in linked curricula.

A new robot in a classroom

Pavel Petrovič

We set on a task to develop a set of 20 different activities with LEGO MINDSTORMS EV3 robots focused on how to use the robots in a classroom on various subjects. As contrasted to most of the activities, work-sheets, courses that are based on this technology, we are not interested in teaching introduction to robotics and control, or teaching programming with robots. In this project, we would like to give teachers in Physics, Mathematics, Art, Chemistry and even Informatics a set of project ideas with solutions that they can 1) adopt to enhance their teaching, for instance when demonstrating a phenomenon in a classroom, or 2) give as a project assignment to a group of canny students to be demonstrated to a whole classroom later on, or 3) simply use in a classroom, if multiple robotic sets are available in the school. We have written a summarizing book in Czech language, but the tasks are available on-line in English as well as part of the Centrobot portal with robtivities.

A practical report on a course of learning by "making" at the university in Japan

Aoi Yoshida, Kazunari Ito and Kazuhiro Abe

At Aoyama Gakuin University in Japan, we offered a course titled “Hands-on Practice in Social Informatics.” We employed a method of learning by “making,” prepared two slogans, and used a wide range of gadgets. This poster describes the course content and students' final products.

After Scratch: Logo(Writer)?

Mícheál Ó Dúill

Massachusetts Institute of Technology Media Lab has been the source of two notable interventions putatively to influence the education of children in the realm computing. The first attempted to introduce a new geometry into schools. The second, Scratch, consequent on the failure of the former, was directed at computer clubs and bedroom-bound connected children. Neither took

cognisance of the curriculum that children followed in school: both developed an isolated skill. Given the prestige of MIT as an institution, this might be viewed as hubris. This paper seeks to consider computing education in primary school from the perspective of the extant curriculum, child development, and the character of the computer as a new educational medium. Logo never having been used in schools, rather turtle graphics, the potential for the less mathematical LogoWriter to serve computing in the context of the core curriculum is evaluated. The author is a primary school teacher, no computer scientist, who concludes that the constituencies of academe and administration will continue to convert children into computers, in their extant likeness, for the foreseeable future; for neither, as Socrates when faced with writing, can envision an education where the new Turing medium is the child's intellectual companion.

Analyzing Twitter Data using Snap!

Andreas Grillenberger and Ralf Romeike

In this paper, we present a software tool which enables students to discover and learn about data stream systems (DSS) in a constructionist way. As DSS are part of the ongoing developments and innovations in data management, which are often summarized by the term Big Data, this tool shows in an exemplary way how these complex topics can be incorporated into school teaching. Therefore, we extended the block-based programming environment Snap!, so that it supports analyzing the Twitter data stream even without having any pre-knowledge on data stream analysis.

And now for something completely different: ToonTalk - a programming language that is not textual, block-based, or procedural

Ken Kahn

The motivation behind this workshop is to introduce some different ways of thinking about computation. As Marvin Minsky wrote "If you understand something in only one way, then you don't really understand it at all" (Minsky, 1984).

Nearly all constructionist programming languages are based upon the idea of users defining procedures. In some cases those procedures are associated with sprites or objects but the range of computation models is narrow. Many languages support concurrent computation but the ways in which these parallel computations communicate and synchronise is limited. Logo pioneered a syntax that was easier for beginners to read, write, and understand. Scratch and other block-based languages introduced a new kind of syntax that makes the construction of programs simpler and much less error-prone. Text and blocks, however, are not the only kinds of syntax possible.

Seymour Papert once described Logo as the result of "child-engineering" the best ideas in computer science. In 1967 the Lisp programming language exemplified these ideas and strongly influenced the design of Logo. Computer science today contains many other ways of describing computation based upon logic, constraints, actors, higher-order functions, data flow, or rules.

ToonTalk (Kahn, 1996) grew out of the goal to once again "child-engineer" the best ideas in computer science. Concurrent constraint programming (Saraswat, 1993) was chosen as the framework for the design of ToonTalk. Another set of computer science ideas that were crucial to the design of ToonTalk was the work on programming by demonstration or by example (Kahn, 2001). Another idea is that the syntax of a program could be not only visual but animated.

This workshop will introduce participants to ToonTalk Reborn (Kahn, 2014) a new web-based implementation of ToonTalk. It runs on any device with a modern web browser, though it is easier to use on a laptop than with a touch device. More details in the paper "Integrating programming languages with web browsers" in the conference proceedings.

No prior programming experience required. Any number of attendees welcome. A projector required. A good Internet connection is very desirable but not necessary.

Assessing Interpersonal Relationship Among Peers in a Constructionist Classroom: a Probabilistic Method

Ploybussara Gomasang, Pintippa Sangwan and Chanikarn Wongviriyawong

This paper proposes an alternative approach to probabilistically assess some aspects of learner's interpersonal relationship with their peers in classrooms using minimal information. We collected the data in a constructionist classroom of 8 students in Grade 2 at Darunsikkhalai School for Innovative Learning in Bangkok, Thailand. Total time spent with peers and the number of peers surrounding a student whose interpersonal relationship we are interested in studying were recorded on a random 17 days in one semester (comprising 60 days). We presented a probabilistic analysis to estimate the expected number of peers surrounding any student who is not the one we are interested in. In this way, we can compare the amount of peers surrounding a student of interest to that of a generic student. The preliminary results showed that a student of interest expressed varying degree of interpersonal relationship in different classes, or learning environments. This method allows us to maximally explore the potential of extracting maximum information from minimum data collection. Moreover, it can be a useful tool to help facilitators identify or design learning environments suitable for certain students.

Beyond lesson recipes: first steps towards a repertoire for teaching primary computing

Chris Shelton

In 2014, the UK government introduced a new National Curriculum for state schools in England with a greater emphasis on computer science and computational thinking. Teaching this new curriculum presented challenges to many primary school teachers and led to a demand for professional development and exemplar teaching resources. This paper argues that many of the resources created in response to the revised curriculum are 'recipes' for lessons that fail to prepare teachers to teach challenging and purposeful computing lessons. It argues that, instead of providing recipes, we need to develop teachers' 'repertoire' of strategies for teaching computing and that our approach to doing this should take account of the context in which primary teachers now work.

The paper describes professional development practices designed to help less confident teachers take their first steps away from model lessons and towards computing projects that reflect the needs and interests of the pupils they teach.

In particular, this paper will focus on two aspects of these practices: a teaching sequence intended to scaffold teachers in planning and teaching computing, and an approach to meeting the needs of the range of learners in a primary classroom through self-directed challenges. These were intended

to support primary school teachers in improving their confidence and capability to plan and teach computer programming.

Bots for Tots: Leveraging 'Ways of Knowing' to Increase Diversity in Makerspaces

Nathan Holbert

Projects designed to give children experiences playing and building with high tech equipment such as 3D printers, laser cutters, and microcontrollers have gained momentum in recent years among researchers, educators, and parents. Despite an explicit commitment to epistemic diversity, makerspaces have struggled to serve a diverse population of creators and have become heavily dominated by men and the highly educated and wealthy (Moilanen, 2012). The Bots for Tots project is an effort to move beyond surface level participant characteristics (such as girls like fashion) and to instead explore the affordances of activity framings and structures that tap into alternate mental dispositions and ways of knowing to broaden participation and interest in maker activities.

The Bots for Tots project engages elementary children to design and build a "dream toy" for younger children in their community. Workshop sessions are designed to engage participants in interviewing stakeholders, brainstorming and critiquing, prototyping, and construction. In a pilot study involving 8 girls and 2 boys, dream toys were constructed using a variety of methods, such as sewing, lasercutting, and 3D printing as well as materials such as fabric, cloth, wood, acrylic, and extruded plastic. While data collection is ongoing, early findings suggest this activity framing may be fruitful as participants drawn to the project were overwhelmingly female, were highly interested in technology and making, and had some experience engaging in craft activities. Further analysis will evaluate the materials and techniques used by participants, how mixed and same gendered teams interacted, STEM content encountered by participants, and the degree to which framing the activity as being about making for others impacted day to day activities.

Bridge of popsicle sticks: A project and a contest

Alejandro Rosas Mendoza, Esteban Pablo Díaz and Avenilde Romo Vázquez

Building popsicle sticks bridges is consider as a relevant activity for engineering students, many professional associations (Professional Engineers and Geoscientist of BC, 2015) and academic corpuses have established contests for different academic levels. As part of his degree thesis, one of the authors opened a contest for engineering students in the University where he teaches and we report some of the results we have found in this contest. By now, students have shown a great interest and participation in the projec

Building mathematical knowledge with programming: insights from the ScratchMaths project

Laura Benton, Celia Hoyles, Ivan Kalas and Richard Noss

The ScratchMaths (SM) project sets out to exploit the recent commitment to programming in schools in England for the benefit of mathematics learning and reasoning. This design research project aims to introduce students (age 9-11 years) to computational thinking as a medium for exploring mathematics following a constructionist approach. This paper outlines the project and then focuses on two tensions related to (i) the tool and learning, and (ii) direction and discovery, which can arise within constructionist learning environments and describes how these tensions were addressed through the design of the SM curriculum.

Communities of Learning Designers in Japan – From constructing products to constructing communities –

Yoshiro Yoshiro, Nanako Ishido, Kazuhiro Abe and Mihoko Kamei

In this panel, we will showcase some activities in which we have constructed communities of workshop designers in Japan in recent years. Through hundreds of thousand years of human history, construction of products have been supported by human relations in the community of people who designed, produced and used the products. It is only very recently that our products are designed to hide the production process and we have lost these relations. The panelists have been active in reconstructing communities in which designers of workshops can exchange ideas and find possibilities to collaborate so that production is supported by human relations. The contents of workshops range from hand crafts, creative arts, computer programming, to community building, and multi-cultural collaboration. In these workshops people with different experiences and skills collaborate to construct creative expressions that are meaningful to everyone involved. We have found out that in these communities in which production is supported by human relations, the constructed meanings gain larger perspectives that are beyond individual workshops and designers. The four panelists will share their experiences of constructing four of these communities of workshop designers that are closely related with each other: Workshop Collection, Programming Education Gathering, Aichi Workshop Gathering, and World Museum. They will then describe how constructionism in Japan has expanded from construction of products to construction of human relations, meanings, and to communities, and discuss about some principles underlying this expansion.

Compassion and Empathy through Inventions: GoGo Board Toolkit for 7-10 years old

Sawaros Thanapornsangsuth

GoGo board toolkit is a hardware-embedded curriculum designed to teach children aged 7-10 years old (grade 2-5) the concept of compassion and empathy through inventions. The toolkit is inspired by children books that adults read out loud to their loved ones before bedtime. Many storybooks are interactive but not so many engender proactive behaviors from the young readers. Scenario storybooks in GoGo Board toolkit aims to help young children observe and understand the problems of others. With support from adults, young children can construct original inventions that help

characters in their stories solve their problems using GoGo Board, scrap or prototype materials, and their imagination. The main objective is to inspire children to be active social inventors who can see the problems of others or themselves and be eager to solve them.

Computational Thinking in School: reviving programming in the context of digital culture

Jose A. Valente

Panel of specialists to discuss and understand:

a) What is computation thinking?

b) Can computational thinking only be developed through programming?

c) What is the relation between what is being proposed as computational thinking and the powerful ideas of Papert? Are we just switching terminology?

The panel should be formed by

1) Specialist from East Europe

2) Specialist from the UK

3) Specialist from Italy

4) Specialist from the USA

Considering approaches to research through the lens of constructionism

Carina Girvan, Nathan Holbert, Chronis Kynigos, Celia Hoyles and Richard Noss

This workshop provides an opportunity for the community to discuss and debate the methodologies and methods used in constructionist research, critiquing existing approaches in relation to both pedagogy and philosophy of constructionism. While there may be numerous texts on conducting educational research, there has been little consideration of how pedagogical theory or philosophy should inform a researcher's approaches. In this workshop, constructionism is the lens through which we explore methodology, methods and tools. We explore several ways in which the process and outcomes of learning through constructionist activities can be uncovered, considering the role of approaches such as design research, randomised control trials and case studies, and looking at data sources such as interviews, data logs, artefacts and observations. The aim is to construct both individual knowledge and a communal understanding of the opportunities and tensions of the approaches we use and the process being studied and is suited to all those with an interest in researching constructionist learning experiences.

Constructionism and microworlds as part of a 21st century learning activity to impact student engagement and confidence in physics

Conor Wickham and Brendan Tangney

The affordances of microworld simulations to promote student engagement and motivation are well documented in the literature. These technologies which can be highly have the potential to enhance a student's learning experience. Nevertheless their widespread use in mainstream secondary school classrooms remains limited as these technologies do not sit well in conventional classroom settings, where short class durations, didactic pedagogy and an emphasis on teaching to the test prevail.

The problems in secondary school STEM education, such as declining number of students considering a career in science related disciplines, have often been linked to didactic teaching styles in classrooms, with an emphasis on transference of knowledge from the teacher to student and where text books are the main source of curriculum content. In physics, teaching is often focused on the application of mathematical formulae and lacks context and applicability to real world problems. As a result many students find physics a 'difficult and hard subject to study' leading to poor motivation and low engagement with the subject. This research brings three key elements together - microworld technology, a constructionist, contextualised pedagogy and a 21st century learning model – to investigate their combined impact on student engagement and confidence in physics. Students worked in teams using a constructionist microworld simulation to build electrical circuits. An exploratory case study was carried out involving 39 secondary school students (aged ~15/16) participating in 4 separate physics workshops.

An attitudinal questionnaire was used for quantitative data capture, while focus groups and observation provided rich qualitative data for triangulation. The findings from the study indicate positive changes in student engagement, confidence in physics and attitude to the use of technology for learning. The qualitative data provides context for these findings, which while being based on a modest sample in terms of the number of participants and duration of the learning experience, nevertheless support the hypothesis that a 21st century pedagogical approach is a suitable framework for exploiting the potential of microworlds to promote engagement and confidence in physics.

Constructionism and the Internet of Things

Marcelo Worsley, Kipp Bradford, Taylor Martin, Paulo Blikstein, Arnan Sipitakiat and Nalin Tutiyaphuengprasert

The intent of this panel is to foster discussion around the role that the Internet of Things has on current and future work in Constructionism, and the role that Constructionism should have in shaping the Internet of Things. We will invite researchers who are conducting scholarship at the intersection of these two areas, in order to highlight some of the forthcoming opportunities and challenges that are likely to emerge.

Constructionism as making construals: first steps with JS-Eden in the classroom

Antony Harfield, Rene Alimisi, Peter Tomcsányi, Nick Pope and Meurig Beynon

JS-Eden is an environment for learners to build software artefacts that relies on construction by 'making construals' using observables and dependencies. JS-Eden is proposed as an alternative to procedural or object-oriented constructionist environments. In this paper we present a small experiment in which JS-Eden is introduced to 25 high school students. The observations and feedback suggest that although there are improvements to be made to JS-Eden's user interface for learners, the principles of constructionism by making construals can be readily applied in a classroom for domain learning. Comparisons are drawn with existing constructionist environments, and it is argued that making construals in JS-Eden is a better paradigm for children engaged in the "instructing", "animating" and "modulating" activities that are key in working with digital media.

Constructionist activity with institutionalized infrastructures: the case of Dimitris and his students.

Chronis Kynigos

The paper discusses the case of Dimitris, a secondary mathematics teacher, who selected three micro-experiments from an institutionalized portal, re-mixed them and then gave his version to his students who in turn made their own changes and constructions. The case is discussed in the frame of the potential for institutionalized portals and digital infrastructures to afford constructionist activity for educators, designers, teachers and students.

Constructionist Archaeology - Digging into Papert Papers Lost and Found

Gary Stager

This community agrees that Seymour Papert is the father of constructionism and although his constructionist activity ranged from 1968 - 2006, much of the discussion at the past few Constructionism conferences has been focused on the "Mindstorms period" of the early 1980s. This workshop represents an attempt to broaden the lens on Papert's work to the last two active decades of his career and his seminal early publications from the 1960s and early 70s.

Over the past several years, the presenter has transcribed more than a dozen Papert speeches and interviews from 1990-2006. Many of the Papert speeches began as video recordings now being published online. Once the transcripts of these "publications" are fully edited, the text and associated media files will be archived online at The Daily Papert (http://dailypapert.com), a site curated by the presenter.

In addition to the newly discovered Papert documents being made available, the presenter has been searching for and sharing elusive papers and articles chronicling Papert's earlier foundational work.

Participants in this workshop will have the opportunity to explore, read, watch, and discuss "new" pieces of the Papert oeuvre. Powerful ideas gleaned from the works may be shared online or during the presenter's related paper presentation.

It is critical to have fresh eyes approach these documents, not just for the sake of constructionism research and sustaining the legacy of Dr. Papert, but to ensure accuracy and make these artifacts available to the entire world.

Constructionist Learning at the Group Level with Programmable Badges

Corey Brady, David Weintrop, Gabriella Anton and Uri Wilensky

This paper reports on early-stage design research oriented towards engaging groups of learners in computationally-rich constructionist activities. The work we present here focuses on computer science (CS) instruction, but the approach is applicable across Science, Technology, Engineering and Mathematics (STEM) disciplines. To enable constructionist learning at the group level, we have created a new computational tool: a programmable and open-hardware electronic badge. In collaboration with Parallax, Inc., a leading educational robotics company, we are developing these badges as a research platform that foregrounds social and interactive dimensions of learning. In this paper, we introduce the CCL-Parallax badge, outline our design motivations, situate the badges within constructionist literature, and describe some of our early activities using them, which fall into three broad categories: embodied participatory simulations, computational systems simulations, and social and distributed maker activities.

Construing and Computing: Learning through Exploring and Exploiting Agency

Meurig Beynon, Jonathon Foss, Antony Harfield, Elizabeth Hudnott and Nicolas Pope

Constructionism is a practice that has developed alongside computing. In addressing a conference of educators in the 1980s, Papert himself recognised that "the new technologies are very, very rich in providing new things for children to do", that a child who used LOGO to make a picture would be unlikely to say "I'm programming a computer", and that "nobody knows how computers will be used in 10 or 20 or 30 year's time" (Papert, c1980). Thirty years later, despite many generations of development in LOGO, and the advent of other programming languages such as Alice and Scratch designed with constructionist aspirations in mind, there is scant conceptual support for computing that is not in essence based on a paradigm of 'programming the computer'. In this paper, we outline an alternative constructionist practice that is based on exploiting computing technology in a way that cannot be accounted for merely in programming terms. A crucial ingredient in this new practice ("making construals") is an epistemological stance that is constructivist in character and derives from the radical empiricism of William James. Adopting this stance enables us to regard the contention by Ben-Ari – fundamental to the idea of programming – that the computer is 'an accessible ontological reality', as itself a construction.

Costa Rica's Omar Dengo Foundation Program: 29 years later

Leda Munoz and Maria Eugenia Bujanda

Twenty nine years ago Costa Rica decided to introduce computers to the elementary public schools, to teach kids to program as a way to promote the use of ICT´s as powerful tools to think, to create and to collaborate. An idea that received at that time many critics. An idea inspired on Seymour Papert´s proposal: constructionism, an idea that bring us all here. And he became close to a godfather to the in-gestation Program.

Nowadays, the Program has endure the roughness of time, and has grown to reach over 2500 schools all over the country. Many lessons have been learnt, and new –as well as not so new— challenges await to be answer in the coming years, but the journey has been fruitful in many ways.

To share this long and intense journey, to contrast it with the experience of many interesting alternatives around, is a nice opportunity to initiate three more decades of work and certainly enrich our agenda.

Curriculum planning in Global Climate Change Application of Public Repository in STEM Education

Xiaoxue Du

"Public Repository" Collaborative Learning aims to enhance the interactions among students and encouraging them to develop scientific inquiry and literary skills on the computer supportive learning environment. The curriculum on global climate change is a pilot study aiming to foster students understanding on how climate change will affect people in the near future. Students have opportunity to conduct research and collaborative in a virtual space to address specific topics related to their own specific local needs, and develop subject-based skills and intuitive knowledge in the learning field.

Darunsikkhailai and its 15 years improvisation on Samba School

Nalin Tutiyaphuengprasert and Yuphin Trangkatarn

Darunsikkhalai School for Innovative Learning in Bangkok is known as the most extreme model of Constructionist school in Thailand since 2001. The panelists

consist of school administrators and facilitators who involved with the effort trying to rebuild a school for learning will be sharing experiences of school's transition over the past 15 years. Experiences of using Constructionism as the backbone of classroom pedagogy embedded with other different learning philosophies will also be sharing in this session.

Designing Interfaces for Special Needs

Michael Weigend

This contribution presents a junior high school workshop on designing physical interfaces with Scratch, the PicoBoard and Sensors. At the beginning the students worked on given starter projects including a car race simulation and a simple version of the game "Pong" using step-by-step instructions. These first projects did not involve the PicoBoard. Sprites were controlled with keys. But it was rather obvious that the keyboard could be replaced by external sensors. In the next phase the students got a PicoBoard and tried out different types of external sensors, including force-sensors, flex-sensors and prototype switches made of everyday material like paper, plastic bottles, wire, sticky tape and aluminium foil. Having gained some experience with this technology, the students were now supposed to develop their own Scratch project, which could be (but did not need to be) inspired by one of the five given starter projects. The only condition was that the PicoBoard had to be involved. Among the student's projects were a lunar landing simulation with a self-made tilt sensor (made of a plastic bottle) and a foot switch and several versions of the classic computer game "Pong" using external switches and audio feedback. Before starting the development, the students (n = 17) answered a questionnaire on personal motives and general design decisions. Why did they pick a certain project? Which aspects raised their curiosity? According to this survey, the

most interesting aspect of sensor technology is the possibility to make a simulation project more realistic. The average rating of this design goal on a scale from 0 (uninteresting) to 3 (very interesting) was 2.12). The design goal "Make a digital application accessible to handicapped persons" got lower scores (average: 1.76) but was still quite relevant. In the context of this workshop, sensor technology did not seem to be a primary motive for programming. Students tended to develop a Scratch project, because they had specific ideas about desired functionality and not because they wanted to work with certain sensors.

Developing Computational Thinking by Using Constructionist and Deconstructionist Learning

Gabrielė Stupurienė, Valentina Dagiene and Gerald Futschek

This workshop addresses all educationists and education scientists who are interested how school students can learn informatics (computer science) concepts and Computational Think-ing through a contest.

The International Bebras Challenge on Informatics is the world's largest contest on Com-putational Thinking. In the 2014 contest more than 925,000 students participated in 36 coun-tries of all continents.

The students have to solve 15 to 21 tasks within 40 to 60 minutes. To solve these tasks, students do not need specific pre-knowledge. Tasks are developed for different age groups, from primary school to upper secondary school students.

The tasks contain concepts of about nearly all areas of informatics. Usually a short story in-troduces a task and states a problem, termini technici are not used, but to solve the task some kind of computational thinking must be applied. There are tasks about concept categories of information representation, algorithms, programming, logic, encryption and many other.

The other point is teachers' constructionist and deconstructionist learning by creating and explaining Bebras tasks.

Eliciting Engineering Expertise From Novices

Tamar Fuhrmann, Marcelo Worsley and Paulo Blikstein

Principle-based reasoning refers to a problem solving strategy that is based on principles. Literature on principle-based reasoning suggests that it is more commonly employed by experts than novices and that it provides a means for advancing one's designs. Furthermore, principle-based reasoning is associated with object-closeness, in that it enables a more embodied interaction with a given structure. However, effectively leveraging principle-based reasoning has historically been challenging. Nonetheless, we argue that constructionist learning, especially in the specific context of engineering design, can be a fertile space for promoting principle-based reasoning and object closeness, even among novices. In this paper, we propose a new model to advocate engineering expertise in novice students by encouraging them to engage principles. Our report includes results from two studies both with novice students: One study (N=22) was implemented in a classroom with first grade students. The second study (N=20) was conducted with high school and undergraduate students. Across these two studies we used a very similar model for engaging students in the

opportunity to leverage engineering principles in approaching open-ended engineering design tasks. Two particular interests of this study were to: 1. Examine ways to effectively evoke principle-based reasoning from novices, 2. Examine if the principle-based reasoning strategy has utility among novice students. Results show that the model employed enabled novice students to demonstrate expert-like practices; novice engineers, first grade as well as high school students, can effectively make use of principle-based reasoning.

Exploring randomness and variability in statistics through R-based programming tasks

Maite Mascaró and Ana Isabel Sacristán

In this paper we present a computational programming activity using R code (http://www.r-project.org/), for exploring randomness and variability in statistics, as carried out by two pairs of 2nd-year university environmental sciences students in Mexico. This activity is part of a larger set of over 30 R-based constructionist and collaborative programming activities, developed over the last 5 years, for the teaching and learning of experimental analysis and statistics, which we presented at the 2014 Constructionism conference (see Mascaró, Sacristán & Rufino, 2014), and that have so far been implemented in 13 university courses in three institutions in Mexico and Portugal, with successful results.

Through these activities, the students carried out explorations in R that helped develop meanings for the concepts of randomness and variability, as well as introducing them to statistical functions, tools and representations, in a "functional" way that they can eventually appropriate for their future research activities.

Game Design with Pocket Code: Providing a Constructionist Environment for Girls in the School Context

Anja Petri, Christian Schindler, Wolfgang Slany and Bernadette Spieler

The widespread use of mobile phones is changing how learning takes place in many disciplines and contexts. As a scenario in a constructionist learning environment, students are given powerful tools to create games using their own ideas. In the "No One Left Behind" (NOLB) project we will study whether the use of mobile game design has an impact on learning, understanding, and retention of knowledge for students at risk of social exclusion. We will use the mobile learning app Pocket Code with partner schools in three countries: Austria, Spain, and the UK. This paper focuses on the Austrian pilot, which is exploring gender inclusion in game creation within an educational environment. We first study differences in game creation between girls and boys. This study that started in September 2015, will help teachers to integrate Pocket Code effectively into their courses. For future studies an enhanced school version of Pocket Code will be designed using the results and insights gathered at schools with pupils and teachers.

Generalization processes: an experience using eXpresser with primary-school children

Cristianne Butto-Zarzar, Joaquín Delgado and Ana Isabel Sacristán

In this paper, we report a research project in early algebraic thinking with students of primary school (10-12 year old) who have not yet been introduced to algebraic syntaxes. Using the software eXpresser, we introduced some algebraic ideas, along with the idea of generalization. This was carried out through problem-solving activities in a didactic sequence. Even though students in this age-group are in transition from additive to multiplicative thinking, our study revealed that students were capable of understanding the idea of sequence, and that they were able to identify the general rule and express it in pre-algebraic terms.

Grounding How We Teach Programming in Why We Teach Programming

Chris Proctor and Paulo Blikstein

This article extends a 2005 taxonomy of languages and environments for teaching computer programming to the current field of pedagogical programming languages and environments. The original taxonomy organized tools according to the barriers to learning programming they addressed, and the strategies used to surmount or avoid the barriers. Updating the taxonomy was not entirely successful; some strategies have emerged as widely-used best practices, and individual tools employ many strategies. Furthermore, as computers and programming have become prevalent in everyday life, it has become difficult to distinguish programming from non-programming, and difficult to distinguish tools for learning from ordinary computational tools. Programming, formerly a specialized activity, has developed into a computational literacy comprising many different forms of cultural interaction. We propose a new taxonomy organizing tools by their literacy aims, based on DiSessa's analysis of the structure of literacy. The new taxonomy allows learners, teachers, and designers to ground decisions about how to learn or teach programming in literacy aims expressing why they want to learn to program.

Increasing Learning Gain in Linear Algebra through Play

Suttipong Thajchayapong, Tanut Choksatchawathi, Paron Israsena and Chanikarn Wongviriyawong

This paper proposes a tool for learning linear algebra we invented called electronic Math (eM), which was aimed to assist learners in constructing mathematical understandings on solving multiple variable equations through play. We conducted an experiment on Grade 7 and 8 students at Darunsikkhalai School for Innovative Learning, Bangkok, Thailand. We found that using this tool, learner's scores on exams increased on average by 32.5% ($p<0.05$, paired t-test). This tool will be further developed to collect real-time data of learner's motion while being engaged on a task to help us deepen our understanding towards reasoning behind for such dramatic improvement in learning gains.

Inquiry Based Learning Project: a study of doing science with elementary public school students

Jose A. Valente

The Inquiry Based Learning Project (Project ABInv) was developed with the objective to study the implementation of an inquiry-based learning approach, so that teachers and students could be engaged in "doing science", using features of the laptop in a 1-1 situation. The project was developed in three public schools and the results described in this article refer to the work developed in one of them. The project focuses on the professional development of teachers and administrators, to enable them to be able to integrate the laptops using inquiry based pedagogy across elementary school subjects.

The methodology used was action research. The university researchers worked with the teachers to encourage and assist them so they could appropriate the laptops according to this new inquiry based approach. It was an ongoing and in service training process which allowed the teachers to continue to work with their students, implementing investigations and using these experiences to debug theoretical and practical concepts about this pedagogic approach. The work developed by the teacher in the classroom followed her lesson plan, although the questions to be investigated were proposed and selected according to the interest of the students. To answer these questions the students had to do experiments, document the results and, based on the results, to come up with answers for the questions.

The results showed that students from first to fifth grade were able to perform investigations on various topics. The first grades were interested in how Brazilian native Indians produced dyes to paint their bodies, as shown in Figure 1a; second grades investigated the legs of the Tuiuiú bird, symbol of the Pantanal region – the fact that the legs bend backwards, different from humans, as shown in Figure 1b; students from the third grade studied the environmental conditions necessary to maintain an organism alive, such as the chrysanthemum plants (Figure 1c); fourth grades investigated organic and inorganic garbage decomposition over time and in different conditions, as Figure 1d; and students from the fifth grade were interested in the conditions for the growth of different plants, particularly bean, lettuce and onion seeds. They did a pilot experiment on the growth of beans (Figure 1e) to determine which type of soil was most adequate to use in their investigation.

The Project promoted the development of the inquiry based learning approach, using the laptop's resources in different situations. It had a great impact on the teachers, students and the school community. Also it allowed the team of university researchers to work with schools and deeper their understanding about the use of technologies in a very innovate situation.

Integrating programming languages with web browsers

Ken Kahn

Logo, Snap!, NetLogo, ToonTalk, and many other programming languages can run in modern web browsers without the need for plugins or installation. This paper is about the new possibilities this opens up: the integration with the wide range of functionality that browsers afford. Browsers support geometric transformations, animation, web storage, events, flexible styling, 2D and 3D graphics, drag-and-drop, multi-media elements, peer-to-peer communication, disability modes,

cameras, microphones, and other sensors. Third-party libraries offer cloud storage, cloud publication, translation to over one hundred languages, and interfaces to social media sites.

A web interface to a programming language and environment can be implemented as web pages whose layout and styling can be customised for different users and contexts. Very different "looks and feels" can be created by users relying only upon HTML and CSS. Customised versions can be embedded into pages to produce interactive tutorials and documentation.

This paper describes ways that a programming language can exploit the web ecosystem. This is illustrated using ToonTalk Reborn, the web version of ToonTalk, as an example. ToonTalk Reborn is tightly integrated with browser elements, events, and styling. Any HTML element can be added to a ToonTalk web page and controlled by ToonTalk programs. Google Drive has been integrated to support sharing and publication of ToonTalk programs. Over one hundred language versions are available due to integration with Google Translate. Drag and drop to and from web pages and other applications supports sharing and saving programs, as well as importing media.

JumpSmart: A Platform for Communal Making and Physical Engagement in Programming

Mikhaela Dietch, Bryanne Leeming and Amon Millner

In this demonstration we present our work-in-progress: a platform for creating called JumpSmart. We are developing to inspire new explorations in patterns and programming logic through open-ended activities for young learners (ages 7-14).

JumpSmart is designed to help young learners acquire new knowledge, abilities and insights through the construction of personally meaningful artifacts. The digital and physical technology of our system is built so that learners can engage in technical processes which resonate with their non-technical interests. Interactions that incorporate novel forms of making can bring computing to more communities and broaden who participates. Programming needs many methods for entry (Turkle, 1992) (Resnick,2009) and we posit that the physical activity is a worthwhile gateway to explore.

We intend for JumpSmart to promote learning through physical activity and extend programming to a wider array of young learners. The kinds of play possible with JumpSmart further the idea of using computers as chalk; rethinking how computation can be used in making through engaging, expressive, and transformative experiences (Millner,2012).

Learning About Complex Systems with the BeeSmart Participatory Simulation

Yu Guo and Uri Wilensky

We propose to demonstrate the third iteration of a design-based research study—BeeSmart—on students' learning about complex systems. Previously, we presented the second iteration—a microworld for honeybees' hive-finding behavior (Guo & Wilensky, 2014). We found that students had difficulties with random interaction between bees in this complex phenomenon (Guo & Wilensky, 2016). Here we introduce our design of a whole-class participatory simulation activity consisting of a HubNet model and a set of inquiry activities to scaffold students' learning about

random interaction. This work enriches the literature of designing constructionist learning environments to scaffold students in learning complex systems.

Learning Emotional Aspects of Digital Competence By Creating Artefacts

Michael Weigend, Lisa-Marie Jung, Sarah Lenzen, Maike Gebhardt, Caroline Flaßhoff, Alisha-Sophie Unger, Julian Wagner, Weronika Jarosz, Stella Krämer and Stefanie Schweitzer

This contribution presents a 45-min workshop on media education designed for 11-years old children (grade 6). After a brief introduction offering some background information, the children are challenged to be creative. They work in groups of three or four plus a student from a pedagogy class (grade 12) as "gamemaster". Using "task cards", the children create stories or images individually and then present and discuss them within the group. After that, each group creates a drawing or Lego sculpture collaboratively. Workshops of this kind covering "cyber-bullying" have been conducted with 120 pupils.

Learning Intentions and Educational Robots

Dave Catlin

Some teachers run excellent lessons with educational robots. Others fail. Good teaching practise, is the key to success and prevails despite diverse and difficult challenges. What is good practice? How can we make sure teachers apply it to educational robots? Constructivism underpins the use of robots, but putting theory in to practise has met with difficulties. The increased focus on curriculum and high-stakes testing makes matters worse. Most teachers I meet feel bullied into "teaching to test" and feel forced into abandoning constructivism for more direct teaching methods. Can teachers deliver lessons that meet their curriculum duties and keep the constructivism spirit alive? These practical questions concern the educational robotic community . This paper is one of a series that looks at these issues.

In previous work, I proposed Assessment for Learning (AfL) answered these questions. AfL summarises good practice and provides a way to improve the success of educational robots. In later papers I looked in more detail how AfL (Success Criteria and Peer Assessment) might work with robots. In this paper I continue this effort by exploring issues to do with educational robots and another AfL strand - Learning Intentions. I review teacher and expert opinion on this topic and develop a definition that works with robots. Finally I use these ideas with selected Roamer® activities to highlight some of application issues.

LevelSpace: Constructing Models and Explanations across Levels

Arthur Hjorth, David Weintrop, Corey Brady and Uri Wilensky

In this hands-on workshop, we will introduce participants to the recently released LevelSpace NetLogo extension. By using LevelSpace, it is possible to programmatically open NetLogo models from inside NetLogo, essentially treating models like agents. This has a wide and interesting applications for modellers, curriculum developers, and researchers interested in eliciting and studying complex systems and how people reason about them. We will introduce the LevelSpace extension's programming primitives and how to use them by building connected model ecologies. We will talk about the different kinds of ways that phenomena might be connected, and how to model that using LevelSpace. We will also discuss our experience with using LevelSpace in classrooms, and discuss best practices for using it as a tool for studying student reasoning within and between complex phenomena.

Little Builders: Empowering At-risk Children by Building and Design

Sawaros Thanapornsangsuth, Yongyuth Laitavorn, Kasidej Phulsuksombati, U-Lacha Laochai, Rachaneeporn Assavanop, Surapat Somsri and Quankamon Dejatiwongse Na Ayudhya

Little Builders is a social enterprise that aims to disrupt Thai education by employing constructionist design paradigms and human-centered design processes in at-risk formal and informal schools to foster Grit and growth mindset. We believe that constructing is a valuable learning process for the students; "children don't get ideas; they make ideas" (Kafai & Resnick, 1996). Little Builders was first established in early 2014 by a group of recent graduates with various backgrounds but a common goal of shifting the Thai classroom from instructionist to constructionist systems, where students can work on their meaningful project, learn at their own pace, and at the same time create a community of learners. Through our two years of commitment, Little Builders has received a grant from Thai Social Enterprise Office and currently has 7 core team members, over 100 active volunteers, and 350 supporters.

Making Constructionism Real in Real Schools Every Day

Gary Stager, Tracy Rudzitis, Brian Smith and Amy Dugré

The panelists work in real schools in New York, Los Angeles, and Hong Kong to make constructionism come alive on a daily basis. This panel will explore their triumphs, failures, and lessons learned for moving an entire school in a constructionist direction and sustaining such progress. Each of the participants teaches programming, robotics, mentors colleagues, develops curricula, and is active in the maker movement. In addition to their day-to-day work of inspiring colleagues, creating productive contexts for constructionist learning, and leadership, each of the participants has spent many years involved in leading Constructing Modern Knowledge, the summer institute for educators built-upon the principles of constructionism.

Math-based Coding Education in Korean School

Han Hyuk Cho, Jin Hwan Jeong, Jong Jin Kim, Yong Hyun Seo and Seung Joo Lee

Recently, the Korean Ministry of Education announced three policies for education -software (SW) education, free semester system, and character education - to strengthen the future skills of learners. The implement into schools of the policies, however, has been hindered by the absence of curricula and the ambiguity of the assessment that meet the purpose of each policy. A way to resolve the problem is proposed in the study by reflecting Constructionism. An educational program, based on Constructionism, will foster the future skills of learners through 'learning by making'. (In Fig. 1,) where the program is summarized, exploratory activities through symbolic coding lead to meaningful experiences through physical coding, which in turn leads to another exploration on the next level. Within the process of coding, symbolic coding exploration is expected to promote learners' computational thinking (CT) competencies and physical coding experience is expected to enhance their career skills and communication competencies, respectively.

Music Blocks Workshop

Walter Bender, Cynthia Solomon, Devin Ulibarri and Claudia Urrea

Our workshop would be a hands on introduction to Music Blocks, software we designed for teachers and learners to explore the fundamental concepts of music in a visual coding environment. Music Blocks is both innovative and beneficial to music education in a number of ways: On the one hand, it is a new method for understanding the fundamental concepts of music; on the other, it is a tool for learning coding and logic skills. It integrates both music and STEM fundamentals in a fun, scalable, and authentic way.

Music Blocks: A Musical Microworld

Walter Bender, Devin Ulibarri and Yash Khandelwal

Music Blocks software is designed for teachers and learners to explore the fundamental concepts of music in a visual-coding environment. Music Blocks is both innovative and beneficial to music education in a number of ways: On the one hand, it is a new method for understanding the fundamental concepts of music; on the other, it is a tool for learning coding and logic skills. It integrates both music and STEM fundamentals in a fun, scalable, and authentic way. Lastly—and very importantly—the tool itself is Free/Libre Software, which we argue is the best choice for an equitable and just education because it gives students the freedom to study, without restriction, both how to use the software and how the software itself works, i.e., how it transforms their instructions into their musical inventions.

NetLogo Web: Bringing Turtles to the Cloud

David Weintrop, Arthur Hjorth and Uri Wilensky

This workshop will be a hands-on introduction to the recently released NetLogo Web platform. NetLogo is a widely used agent-based modelling (ABM) environment that has widespread use in classrooms and research laboratories around the world. The NetLogo Web project brings this popular platform into the cloud, making it fully accessible through any modern browser. This means netbooks, tablets, and even smart phones, can now serve as platforms for designing, implementing, and running powerful agent-based models. The goal of this workshop is two-fold: (1) introduce learners to the next iteration of NetLogo and (2) demonstrate the pedagogical and expressive power of having a fully functional ABM environment in the browser.

New Frontiers in Educational Robotics with the Raspberry Pi and the GoGo Board

Arnan Sipitakiat and Paulo Blikstein

This workshop will offer a hands-on demonstration of how small embedded-computers such as the Raspberry Pi can offer new possibilities in educational robotics. We aim to demonstrate (A) how off-the-shelf peripherals can be utilized, allowing learners to use devices like webcams, GPS, SMS Air cards, and Wifi in ways that would have been too technical before. (B) We will present the GoGo Board, which snaps on top of the Raspberry Pi and allows the Raspberry Pi to control motors and read sensor values. (C) Programming will be done using Tinker, a new graphical environment that integrates the various components into a single straightforward platform.

On controlling LEGO Education platforms from Imagine Logo

Pavel Petrovič

Imagine Logo is a successful product that has not been replaced with an equivalent tool in many ways and in many places. In this poster, we present our work of interfacing Imagine Logo with most of the LEGO Education robotics platforms, including RCX, NXT, EV3, and the CtrLab from the 9Os. This contribution is important to overcame the conceptual limitation of the program-download-run paradigm that is enforced by all LEGO MINDSTORMS products, thus making it very inaccessible for children to learn by creating interactive projects that combine the external robotic hardware with an interactive software they write and that runs on a computer simultaneously. Our tools bridge an excellent learning environment based on Logo language with an excellent robotic platform resulting in joyful playground for a brave teacher.

On the Road to Sustainable Primary Programming

Ivan Kalas

In recent years we witness a new intense outburst of interest in educational programming in several countries, including their primary or even pre-primary stages. Constructionist educational programming for everybody has been the main principle in our development and research since our first influential implementation of Logo programming environment for Windows in 1993. However, until recently we have not experienced systematic, nationwide, long term, thoroughly built, sustainable and properly supported integration of educational programming into formal school

systems – in spite of the fact that several countries have declared such policy materialised in their (sometimes even mandatory) subjects named Computer Science, Informatics, ICT or Computing.

Therefore, it is natural and legitimate to ask whether this wave of interest in educational programming differs from the previous ones, which had never managed to reach the level of permanent presence in naturalistic classroom settings – especially in primary classroom settings. In my presentation I will argue why there is now a chance to achieve this and which factors I think must be thoroughly taken into consideration to build sustainable and broadly accepted educational programming at primary level.

In general, for primary programming to really work and sustain, it needs to ensure that: (i) Learning it is relevant for the primary learners and leads to meaningful progress, (ii) Primary schools (i.e. the school administration, teachers and indirectly also parents) are supportive and supported to adopt it, and (iii) External circumstances do not restrain it.

In my reflection I will focus on the first two requirements which we as researchers and developers have a potentially greater opportunity to influence. I will primarily draw on my current exceptional opportunity to engage with two different primary educational systems – that of England and Slovakia. In the presentation I will try to synthesise the experience accumulated at Comenius University and London Knowledge Lab.

Papert"s sort-of-right mathematics

Jean-Francois Maheux

In this theoretical paper, I react to a comment made by Papert in relation with the "sort of right" answer he obtained with a logo program he made to solve a mathematical task. I argue that mathematics and mathematical activity are often sort-of-right, despite the usual impression that mathematics is the culprit of "perfection". I give examples of the presence and importance of sort-of-right mathematics in the discipline, and in school. I conclude with a reflection on the possibility to give more importance to sort-of-right mathematics in regard with teachers and students vision of mathematics, and its resonance with Papert's writings about what education ought to be.

Preparing teachers for the Digital Technologies Curriculum: Preliminary results of a pilot study

Elena Prieto-Rodriguez and Daniel Hickmott

The Digital Technologies (DT) curriculum in Australia, particularly at primary school level, has been considerably expanded in the recent past from the teaching of digital literacy to the teaching of the skills necessary to create and innovate with digital technologies. The concepts of computational thinking, systems thinking and programming are part of this new curriculum. This paper presents the theoretical perspective, methodology and preliminary results of a research project, currently being run to explore different pedagogies for teacher preparation.

The objective of the project is to pilot a research informed strategy for teacher preparation for the DT curriculum and articulate terms of best practice. To do so we are using as a test case a group of teachers participating in a Computer Science 4 High School (CS4HS) initiative at our institution. We hope that by sharing our experience and methodology, we can receive feedback on how to improve

on the second phase of this project, and find ways to increase collaboration with other teacher educators.

Programming videogames with models of physical parameters: some examples

Angel Pretelín-Ricárdez and Ana Isabel Sacristán

In the past three years we have been involved in a project (Pretelín-Ricárdez & Sacristán, 2015) with last-year engineering students at the National Polytechnic Institute in Mexico, where they are presented with a sequence (stages) of individual and collaborative activities for constructing (designing and programming) videogames that have mathematical models (e.g. fluids, simple machines, robots, digital circuits, physical parameters, etc.) integrated into game mechanics. With this, we want students to apply their mathematical knowledge in their model and videogame constructions, and in this way learn to situate or contextualize it, as well as relate it to other disciplines, as is required in engineering in real life.

In this paper, we provide four examples of students' designs during the first stage of the activity sequence, which corresponds to the learning or familiarisation with a game engine (in this case, Game Maker Studio), its physics engine and its programming language. In this stage, we ask students to design and implement experiments to characterize a set of basic physical parameters used in the game engine: density, restitution, friction, linear damping, angular damping, velocity, force, impulse and acceleration of gravity. The purpose of this, is that during the design and implementation of experiments, students learn to relate the meaning of a command or piece of code, and other computational objects (sprites, backgrounds, sounds), with a concept (mathematical or physical) or mathematical equation. By assigning objects (Fig. 1) with mathematical or physical properties, they can develop a videogame (Fig. 2), where the correlation of meanings, helps build more complex models.

Pyonkee: A Scratch compatible visual-programming environment running on iPad

Kazuhiro Abe and Masashi Umezawa

Pyonkee is a visual-programming environment running on iPad. It is based on Scratch 1.4 from the MIT Media Laboratory. Since Pyonkee is fully compatible with Scratch 1.4, millions of existing Scratch projects can be used for reference. Pyonkee's user interface is optimized for touch devices. We do not need cumbersome typing, even a mouse. Just write programs wherever you like. Pyonkee nicely supports pinch-in/out, and font scaling for small devices. Moreover, sound recorder and camera are provided for importing your sounds and pictures into the projects. We can mix various media on Pyonkee and program them.

Redefining learning through constructivist/onism practices in early childhood education: is this possible? A case studu of a teacher during her participation in a continuing professional development program

Chrystalla Papademetri-Kachrimani and Marianna Efstathiadou

Despite the consensus in literature that young children are capable to “work” with “hard” concepts, early childhood teachers find it difficult to incorporate this kind of practices in their classroom. In this paper, we present a case study of one in-service early childhood teacher in Cyprus who participated in a Continuing Professional Development (CPD) program which aimed at supporting teachers to make a shift from traditional teaching strategies to alternative learning approaches and even more redefine learning in early years mathematics. Through the description of activities that this teacher implemented before and during her participation in the CPD program and through her reflections concerning her practice a year after her participation in the program, we aim to present how this teacher managed to change her practice and her way of thinking about learning radically.

As Papert (1990) states what you ought to be learning at school is that you don’t need to be taught in order to learn. In this paper we see how we can approach teacher’s learning this way and consequently supporting them in order to make a shift in their practice towards constructivist approaches.

Report from the Future: The Next Generation High School

Brian Harvey

The US government kicked off a “next generation high school” project with a week of events in November, 2015. I attended the National Science Foundation forum “Next Generation STEM Learning for All” November 9 and the White House “Summit on Next Generation High Schools” November 10.

There is a lot of good news for constructionists from these events. The emphasis is overwhelmingly on project-based learning, and at least some of the featured model schools talk about the importance of learner-chosen projects and of public display of the results.

There is also some bad news: First, the “next generation” narrative presents the 20th Century as if it were nothing but rote learning, ignoring the strong progressive education movement that started several centuries (or, in some views, millennia) ago. Second, more importantly, the narrative is posed entirely in terms of job requirements—the 20th Century had factory jobs, but the 21st Century has information jobs—as if job training were the sole, or at least main, purpose of education.

Resituating Constructionism in the Space of Reasons

Kate Mackrell and Dave Pratt

Constructionism is described by diSessa and Cobb as a 'framework for action’, and is built upon the orienting framework of constructivism, together with an assumption, born out of practice, that engaging students in making activity (bricolage) is especially felicitous for learning. It has been further elaborated through the work of Noss and Hoyles to include constructs such as situated abstraction and webbing, and through the work of Ainley and Pratt to include purpose and utility.

However, constructivism is increasingly being criticised as a model for learning (Roth, 2011): a major issue is that it tacitly endorses the Cartesian mind/world split in which learning consists of constructing knowledge (representations) of the world in the mind. Furthermore, constructionism seeks to add the affective to the account of intellectual development proposed by constructivism without providing theoretical underpinning for this addition. Hence constructivism no longer serves as an adequate orienting framework for constructionism.

We suggest that contemporary work within philosophy (Brandom, 2000; Bakhurst, 2011; McDowell, 1996) provides a more fitting narrative. We argue that the idea of learning as initiation into the space of reasons (Bakhurst, 2011) provides grounds for a synthesis of the affective and the logical. We argue that inferential reasons and reasoning encompass not only the powerful ideas of mathematics and disciplinary knowledge of modes of enquiry but also the extra-logical, such as in feelings of the aesthetic, control, excitement, elegance and efficiency.

Restructuration in Practice: Challenging a Pop-Culture Evolutionary Theory through Agent Based Modeling

Umit Aslan and Uri Wilensky

An ordinary, non-scientist person's exposure to science through pop-culture is ever growing. However, science is still believed to have a high threshold of entry. For most people, doing science means going through rigorous training of literature, specialization, and learning formal mathematics. Many people feel that they have no means to figure out which idea is scientifically accurate and which one is inaccurate. More importantly, they only have the trustworthiness of the source as heuristic for believing or not believing in a particular scientific message. In this paper, we argue that agent-based modeling has the potential to lower the threshold of entry to science and to empower just plain folks against the flood of scientific messages in pop-culture. To demonstrate our theory in practice, we conduct a thought experiment in which we extract a much debated scientific theory, the evolution of sexes, from a BBC Earth documentary and show how one can easily recreate and explore the assumptions of such a theory using the NetLogo agent-based modeling environment. Then, we compare traditional formal mathematics based scientific analysis approach with our agent-based modeling approach and show how the latter affords people with little or no training in high level formal mathematics or evolutionary biology literature to challenge scientific ideas.

Robot Programming Workshop for Middle and High School Girls

Miki Matsumasa, Chieko Harayama, Kazuhiro Abe, Nobuko Kishi and Manabu Sugiura

We held programming workshops for middle and high school female students using Scratch to program educational robots. We presented the educational robots, Romo, as social robots to the students and asked them to design programs to improve the interactions between human and robots. We believe we were able to have the students, novice programmers, imagine the future society with very low cost robots in our daily life. In this paper we would like to describe the workshop outline, the interaction programs that the students created in the workshop and the feedback that we received from them.

Samba School of the 21st Century : Learning in the Break Dance Community in Bangkok

Nalin Tutiyaphuengprasert

The objective of this study is to observe the mechanics of learning in this dance community. I have also analyzed one case study in depth from observations and an interview of a dancer who found that Bboy dance experiences transformed his life and helped him improve his academic achievement in school. This study might give us some ideas on how to redesign learning and intervention in order to deliver "Samba School" (Papert, 1980) learning experiences in formal school context.

Summer League: Supporting FLL Competition

Pavel Petrovič and Richard Balogh

In the years 2013-2015, we organized three years of a comptetition in building and programming robots in Slovakia named Letná liga FLL (Summer League of FLL). We invented and designed the competition format. All the tasks are our original ones. The competition has a unique format allowing the teams to compete remotely, eliminating all travel costs. It drops the requirement of time-demanding preparations lasting many weeks that is present in most common robotics competitions, such as RoboCup Junior, FIRST LEGO League, and World Robot Olympiad. However, this competition stimulates an unprecedented level of creativity and provides an early and manifold feedback in a repetitive fashion. All solutions of the teams are published after the deadline, each being unique and special. After extensive, but well-motivated work on every task, each team compares their own solution with a plethora of other ways of thinking about the same problem. Children learn from each other on a great scale. We experience an euphoric shock and a feeling of nirvana when evaluating the various solutions after each round. The feedback from the participants has been positive and the dedication of many is beyond our early expectations. This format stimulates a regular and goal-oriented work in the after-school robotics clubs. An additional valuable outcome of our work is the set of 30 creative activities focused on various aspects such as robot design, robot control, programming, use of sensors, navigation, manipulation, physics, art, and other. Each taks has multiple and inspiring solutions. Activities can be solved in 1-3 club meetings. Everything is freely available on-line.

Tatrabot - a mobile robotic platform for teaching programming

Pavel Petrovič

We have developed a low-cost robotic platform that we use to teach first grade undergraduate students programming in C language. After the study program in Applied Informatics has been redesigned, our students learn programming in high-level programming language Python, which has automatic memory management, advanced data-structures and algorithms. Demands of some of our courses however show that the students lack the understanding for bits and bytes, low level programming and loose connection to the actual processes that occur in hardware when their software is being executed on a machine. We think it is important to understand this level too, if the student is to program efficiently and correctly. Furthermore, playing with robots stimulates and motivates freshmen students, makes the study program more attractive, and allows more playful learning, improves the overall experience and shock from entering the University. In this

demonstration, we will show you the robot, its capabilities and how we have used it in our course on Computer Hardware.

Teachers' Constructionist and Deconstructionist Learning by Creating Bebras Tasks

Gabrielė Stupurienė, Valentina Dagienė and Gerald Futschek

The constructionist theory of learning offers useful ways for thinking about how computers and digital tools can be included in education. Deconstructionism as an extension of constructionism is a natural way in children behaviour while exploring new tools. Constructionism and deconstructionism can be applied both in the classroom and in outreach school activities. To support constructionism and/or deconstructionism, we need to focus on supporting teachers. This paper explores a main question: How teachers may learn in a constructionist and deconstructionist way. We discuss this question from the perspective of the Bebras challenge on informatics and computational thinking. A contest and supplementary activities have been performed for more than ten years by many countries. We focus on one side of the challenge – the development of tasks. We present our experiences from several years of Bebras teachers' workshops. In this paper, we provide two task development stories focussing on teachers' constructionist and deconstructionist learning.

Teaching computer science teachers: a constructionist approach to professional development on physical computing

Mareen Przybylla and Ralf Romeike

With the integration of physical computing into computer science curricula in K-12 schools, there is a need for professional development of teachers in this topic area. This article discusses design principles for professional development workshops and reports about practical experience. In particular, the paper describes the development of six principles that were successfully used in planning a workshop on physical computing. The workshop's aim was to empower teachers with wide interests to implement physical computing in computer science classrooms. The workshops' design allowed each teacher to follow his or her personal objectives, to gain hands-on experience in a constructionist learning environment and to reflect on their experience with their colleagues.

Teaching programming constructively and playfully

Ildikó Tasnádi, László Csink and Károly Farkas

We demonstrate our best practice to develop IT vision and thinking in school education and how we link the various subject groups to IT. We wish to show that writing programs is the best game to play with the computer, because it is better to command the computer than being commanded by it. To teach programming should not simply aim at practical competence but also to develop cognitive skills similarly to teaching math, but in many respects more effectively. The basis of our pedagogy is to make the material playful in accordance with Papert's principles. (Papert, 1980) In addition to body and ego syntonicity (self syntonicity) we also apply cultural and social syntonicity and we endow our objects with cultural and behavioural features of humans. We have experimented in a secondary training school in two age groups: 6-10 and 10-14. For the young group we use our own

educational package, for the older group we use a freely available package (Fling the teacher). We also describe our experiments in teaching programming for the second group.

technicity

Mícheál Ó Dúill

A quarter of a century after Seymour Papert tentatively suggested constructionism might be provided with a scientific foundation it is a disgrace that his followers still wrap themselves in a 'philosophy' comfort blanket to insulate them from challenge by non-believers. It shows an unwillingness to dive into beckoning deep psychological and epistemological waters fearing cherished beliefs will drown therein. For the fourth time I call upon the constructionist community to take the step from sect to science.

The fundamental proposition remains that which I outlined at the Paris conference and further developed at Athens and Vienna. BH rather than classical entropy is now used. This gives a constructional foundation from which information naturally flows. The entropy differential between technological and biological forms, which caused a degree of uncertainty previously, is now resolved by reference to DNA information. The paucity of the stimulus, successfully used against the stimulus-response theory of language learning, is used to demonstrate that all information from which percepts are produced lies within the brain. Further, that this information, the product of aeons of evolutionary adaptation, is not congruent with physical reality. Unaided cognitive construction cannot, therefore, provide an accurate view of the world. The technology that we are uniquely capable of producing as a result of access to Hubel information must conform to physical reality. It is our species' corrective lens.

Because constructionism was built around the introduction of the computer, or Turing medium as I call it, I make some remarks about its role in education relative to paper and pencil-eraser. As writing, taught in the developmental phase from five to ten has turned children into competent computers, the new medium similarly applied would create new minds for new challenges. This is the constructionist challenge.

The Imaginatorium

Eleonora Badilla-Saxe and Florencia Morado

The Imaginatorium is a low-tech Maker Space being installed at De La Salle University in Costa Rica. It has its roots in the Fab Lab from the MIT Media Lab, the LuTec at the Institute of Technology of Costa Rica and the Patagonia Lab (Pata Lab) in Chubut, Argentina. With Constructionism at its heart, The Imaginatorium aims to stimulating innovative and creative people, mostly generous with their knowledge looking forward a more caring, equitable and peaceful world.

Turtles All the Way Down: Presenting LevelSpace, a NetLogo Extension for Reasoning about Complex Connectedness

Arthur Hjorth, Corey Brady, Bryan Head and Uri Wilensky

In this paper we present LevelSpace, a fundamental extension to the NetLogo agent--basedmodeling language and software. NetLogo provides a low--threshold, high--ceiling environment forcreating

models of complex systems;; LevelSpace enables multiple NetLogo models to interactwith one another in “model ecologies.” The LevelSpace extension does this by allowingcurriculum designers, researchers, and learners to programmatically open, run, and closemodels from inside the NetLogo language, thus allowing entire models to function as agentswithin Multi--Level Linked systems.The paper first presents existing research on using agent--based models (ABMs) in education asa supportive environment for fostering complex systems thinking. It then argues that existingdesign tools are limited in the ways in which learners can engage with and question theassumptions built into ABMs or the conceptual boundaries that ABMs implicitly or explicitly drawaround the phenomena they model. As a remedy for these limitations, we present LevelSpaceand demonstrate how we have used it in two early studies to support and study thinking aboutMulti--Level Linked systems. We argue that connecting models in this way is a powerfulconstructionist design tool, both for eliciting thinking about individual and linked systems and forbuilding and refining such systems in educational contexts.

Videogame construction with models of physical parameters

Angel Pretelín-Ricárdez and Ana Isabel Sacristán

In this workshop, participants will construct videogames that require the use of models of basic physical parameters (e.g. friction, force, velocity, gravity, density, linear damping, angular damping) in the game mechanics within the story. It illustrates an approach where students can gain a deeper understanding of those physical concepts, their functioning and possible applications in realistic systems or situations (RSS) from physics, computer science, etc., in a fun constructionist (Papert & Harel, 1991) way (the videogame construction.

The workshop consists of a learning sequence with three activities (see further below) where the following construction cycle is carried out (see Figure 1): (1) A RSS is proposed related to engineering; participants will have to model this RSS for implementing it into the game mechanics of a videogame. (2) Participants will need to identify the physical parameters in those RSS and describe them through algebraic formulas or equations (help cards will be provided for this): this is a first mathematical characterization. (3) That first mathematisation of the RSS will need to be converted (abstracted) into a working model in the game engine computer code, in order to: (4) test it and validate it, in a first simulation. Here are two possibilities: If the implementation does not work, then (5) the model needs to be simplified or adjusted –i.e. abstracted again through the manipulation of computational objects and programming code, repeating steps (3) and (4). If the simulation runs properly, then we go to we have a model in context (6) that is ready for the final implementation in the videogame (7).

What would the ideal constructionist programming language (or languages) be like?

Ken Kahn

In a discussion about future programming languages with Seymour Papert, he asked the question whether their design should be driven by mathematical aesthetics or engineering. He thought that most current efforts come from engineering criteria and was uncertain if that was good or bad.

When designing a constructionist programming language one must make choices about the underlying computational model, the syntax, the programming environment, and the extent to which it is compatible with existing languages and systems.

What are the ultimate goals of a new programming language?

Should we strive for a single ideal language or would multiple languages be best? (Kahn, 2007) brings up many of these questions.

Logo, and more recently Scratch, has played a foundational role in constructionist learning. Could something other than incremental progress lead to much better tools for using computers in a constructionist manner? What lessons can be learned from existing languages such as Logo, Scratch, Snap!, NetLogo, ToonTalk, etc.?

What's New in Snap! and BJC

Brian Harvey

Snap! news includes keyboard-based script editing (the beginning of support for visually impaired users), the ability to include Javascript code in a Snap! block definition, and (thanks, Citilab!) the ability to create standalone applications from projects.

BJC news includes two major curriculum efforts: BJC is now live on the edX platform, and a substantial rewrite with supporting teacher materials is under way to make BJC easier to use and more successful in high schools. Also, we have taught BJC to the first 28 of a planned 100 New York City public high school teachers, and they are teaching students (mostly 17-year-olds) this year.

Working toward Equity in a Constructionist Scratch Camp: Lessons Learned in Applying a Studio Design Model

Deborah Fields, Lisa Quirke, Tori Horton, Jason Maughan, Xavier Velasquez, Janell Amely and Katarina Pantic

This project examined learning in a series of three, week-long Scratch summer camps intended for novice kids aged 10-13. In this paper we share our approach to building a more rigorous and equitable constructionist learning environment by applying an art studio design model of pedagogy to computer science. Our goals are: 1) to articulate our application of the studio model of design to learning programming in the Scratch Camps, 2) to investigate how widespread and deep campers' learning was, and 3) through this investigation to consider lessons learned that can be applied to future constructionist learning environment designs. Our study applied quantitative and qualitative analysis to a combination of automated backend saves of campers' projects, observational data, and frontend saves of campers' projects.

Workshop on Game Programming in Scratch

Tomohito Yashiro, Kazushi Mukaiyama and Yasushi Harada

In the workshop, children first brainstormed ideas for computer games with a facilitator. Second, they planned how to program the games. Third, they programmed their own, original games

following their plan. Finally, the children planned future work on their game. It is our hope that this workshop provided the children new experiences in planning and execution. The workshop results showed that game programming was good for the children, as it encouraged their interest and motivation. Additionally, the children were interested in each other's work. In the stage of the workshop where the children planned their work, we represented their ideas on paper. The paper enabled the workshop staff to visualize the children's ideas and the appropriate programming procedures. Additionally, the children used the paper to describe their ideas easily because the facilitator showed a model of planning in the programming lesson using the paper. We concluded that having a tool to visualize the children's thinking was effective in the programming workshop. In addition, we considered that it is important to prove the usefulness of the tool through its use by the facilitator.

World Peace Song Project

Yoshiro Miyata and Mihoko Kamei

We use products and energy from all around the world. We have constructed a global community connected physically through the products and energy we use. However, we have not connected our hearts globally and created many global problems concerning food, energy, environment, often resulting in conflicts (Miyata et al. 2015). Collaborative music making has been a powerful means to connect our hearts. We would like to connect our hearts globally by making music together globally.

We propose a workshop in which the participants will be able to experience the process of creating music in collaboration with many partners around the world, all singing lyrics they have created expressing peace in their own languages. We welcome participants with many different nationalities, native tongues, ages and genders, to express their feelings and thoughts about world peace in their native languages, and sing together in a global chorus with World Museum partners around the world who will be listening to us online and send messages to us in real time.