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Overall evaluation

edited by Márta Turcsányi-Szabó (ELTE-HU)

using contributions from:

- *Márta Kőrös-Mikis (local educationalist), Sándorné Pattantyús-Ábrahám (educataional evaluation diploma work), József Windisch (educataional evaluation diploma work),, Márta Turcsányi-Szabó (head of HU team and coordinator) - HU*
- *Ivan Bezak (local educationalist), Ivan Kalas (head of SK team) - SK*
- *Julian Pixton (internal evaluator) - UK*
- *Carlos Barreira (local educationalist), Secundino Correia (head of PT team) - PT*
- *Mirosław Dąbrowski (local educationalist), Andrzej Walat (head of PL team) - PL*

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1. Introduction

Informational society is the society of self-generating learning, where knowledge is the main source of economic value. Working in any field of knowledge-based economic system one needs to understand the bases and working methods of tools used in order to do one’s job adequately and effectively. Thus, in the huge challenge of the 21st century, it is not the least unimportant *what*, *when*, *how* and *why* students learn and what kind of abilities the teachers/mentors (who help them in doing so) have. Innovative change in relation to gaining knowledge is the key to success and progress of our present days.

Informational society means a challenge to schools since it reshapes the organizational and institutional forms of learning and teaching. The nature of knowledge changes: it becomes trans-disciplinary, multimedia based and practice based. At the same time, the forms of gaining knowledge also change, life-long learning becomes universal, and formal school institutions give way to virtual environments to a more open form of learning. To turn information into knowledge we need to change our learning methods and teaching environment.

In education, Information and Communication Technologies (ICT) is the new medium of pedagogy, under which we mean the system of educational methods and tools based on information technologies. Also a new group of pedagogical methodologies, called “digital pedagogy”, are surfacing – it attempts to discover the most effective methods and contents for computer-aided teaching. However, this complex educational environment demands a new perspective on pedagogy and its practice: it cannot be used without re-thinking the whole condition-system of education.

The use of teaching tools is as old as teaching itself. Their role is to help the students on their path in acquiring knowledge, to make it easier to grasp complex concepts. There are some more abstract tools, especially among the modern ones, that are not designed to introduce the students to some specific subject but to reinforce the psychological fundamentals of learning. These are typically aimed to improve skills and capabilities, and were introduced into the classrooms with the arrival of computers.

One of the teacher's important tasks is to purposefully improve the student's skills and capabilities – and in a way that is highly tailored to suit each student's personality with careful differentiating. On some areas (e.g. manual abilities) there is a wide selection of teaching tools and literature – other areas are unfortunately (and undeservingly) overlooked. One of these areas is the development of mental abilities and problem solving strategies.

2. Background

2.1 Tools

The environment in which children play, communicate and learn is gradually becoming the same where adults communicate, work, learn and look for entertainment. Clearly, the Internet is turning into a kind of organic learning environment. Through it, children are able to learn without the help of adults, searching for those topics that interest them most. This gives them a sense of authority and builds their self-confidence. In many cases, younger generations learn the characteristics and usage of the new technology first, and they are the ones to pass the information to their elders – doing so very effectively and in a most natural way.

Imagine is a member of the new generation of *Logo* programming languages. It is designed for those students who are keen to work on such wide-range activities as drawing and animation, web-design, traditional *Logo*, creating multimedia applications, using speech inputs and outlets, modelling, developing topic-specific learning environment, sharing ideas, organizing presentations, creating projects and microworlds for the development of counting and reading activities or other sciences, working with different kinds of data. *Imagine* combines object-oriented structure with the traditional *Logo*. It promotes the hierarchy of objects and behaviour, parallel but independent processes, actual drawing tools, an enlarged surface for direct manipulation and other characteristics. The main objective of *Imagine* is to provide students, teachers and designers with a truly interesting instrument for the learning process.

Imagine is an authoring system that is accessible to everyone regardless of computer skills. It allows its user to concentrate on the actual content and the message to be delivered. No programming skill is required to make use of many of its features. It enables everyone to paint, to make animations, to edit web pages, to create logo and multimedia elements, to create sounds, to model, to share their thoughts with others, to create presentations, to conceive projects, to write computer programs, to control the work, to manage data, to compose music or even to establish a real-time interactive broadband connection. From a pedagogical viewpoint, its most important cornerstones are:

- Constructiveness
- Communication
- Collaboration
- Creativity

Logo is an education philosophy; it is also an ever-growing family of programming languages that are designed to promote this philosophy. It is the order of importance: it is primarily an implementation of a set of governing principles, mostly laid down by Swiss psychologist Jean Piaget, who has studied the learning process of the children for decades, that prefers constructive learning methods. Logo is a related programming environment that has evolved continuously in the past, nearly 40 years and is still actively developed. It is just a tool that attempts to satisfy the children's thirst for knowledge in an interactive way. And Colabs project is based on these vitally important concepts, namely: constructiveness, communication, collaboration, and creativity.

2.2 Logo and improving thinking

Although Logo in the nineties has become the predominant programming language in the elementary school education there are signs that the interest in Logo is fading in the Western countries. It is surprising, especially since many studies were conducted to explore the impact of Logo on the students and as a result we have a large body of evidence showing that Logo has a very positive effect on the development of the children's problem solving skills.

On the other hand, the studies shed light on the shortcomings of Logo: if Logo is taught only as a programming language, it has very little positive effect on developing the general intellect. One of the possible reasons is that not everyone finds programming a fascinating activity and the general principles of programming methodologies accepted in computer science proved to be unfit for general use in elementary education. Classes that lacked any methodology did not have any positive effect and the same can be said for classes where control was too strict: the excessive control did not let students' abilities to unfold and as a result they felt distant from the process of problem solving thus their abilities did not improve.

Experiences show that using related motivating activities improves the efficiency of Logo in the learning process. A typical example is the drawing that is required for visual problem solving; drawing is one of the favourite pastimes of the younger children in the lower grades so it probably catches everyone's attention.

Using Logo effectively in education requires finding the golden mean: the relative freedom of the students (constructive learning) and requires well-organized guidance from the teacher/mentor. The primary usage of Logo in elementary education is not to teach a programming language but to purposefully use a tool that is very well fitted to describe mental strategies. So Logo should not be taught in a too scientific manner and one should not be lost in the details of the language – the main focus should be on the general problem solving principles that can be applied to a broad range of interesting problems. An important requirement for the subject matter is that students should be able to relate to it.

Most of the well-known comprehensive studies that were conducted on the use of Logo had positive results and they provide convincing evidence to the use of Logo in education and they accurately represent the intentions behind the experiments that were carried out to study the effects of using Logo with children (Erik De Corte, 1993). It should be noted that most of the tests were carried out with children attending not only lower grades of elementary school, but high school and college students also participated in the tests.

We dare to mention another test now that the results are known: The experiments conducted by Turcsányi-Szabó and Windisch between 1999-2000 on 3-5. grade students showed significant improvement in the visual problem solving ability using convergent/divergent methods, that has particular significance in the area of getting students performing below average to close up into line (Windisch, 2000).

2.3 Microworlds

A Microworld generally means an educational program. Seymour Papert calls them the “incubators of knowledge” (Papert, 1980). In the world of Logo – and particularly, Imagine Logo – microworlds are frequently encountered since they are relatively easy to develop (in theory, every teacher – or even child – who knows Logo should be able to do so), they are persuasive and they offer tools for learning.

Their main attribute is a reduced instruction set (not necessarily in a verbal form: it may be a set of actions) that has two advantages: first, the students do not get lost between the many possibilities, second, the teacher can enforce the use of some selected instructions that serve desired purposes. The selected instructions can be placed on a button bar (like in the experiments presented here) so the students do not have to type and the full range of the instructions is always visible.

A microworld, a digital educational environment can be constructed for nearly any subject and can bring new colours in form of playful manipulatives into the classroom.

Experience shows that the students are enthusiastic about them: especially the younger ones are fascinated by the possibility of manipulation offered by the computer and the phenomena that the computer “knows” what is being taught to them, which inspires them to learn.

2.4 Collaboration

The classical setup of the school's educational process is the student-teacher relationship. The teacher communicates information to the students, helps them to comprehend it and later checks the students' knowledge*. The student's role is to learn. This relationship is surrounded by other relationships that are often* considered as of secondary significance: the active relationship between students and the active and passive relation between students and teaching tools.

Collaborative learning is a process that exists in unstructured team conditions, where every single member of the group takes part in the problem-solving process equally and there is no pre-mediated division of work forced on the group. Co-operative learning is an outer, environmental process that is built upon social interaction and requires co-operative strategies. When realizing the Colabs experiment, the latter learning method was emphasized, since the learning process is only successful if it is well-organized and a sufficient mentor, methodology and techniques are provided.

Besides the mutual trust-based teacher-student relationship, the teacher has to pay attention to and be supportive of the student-student relationships. This should not only be done because of social development but also to incubate knowledge and to take advantage of the synergy effect. In traditional school education this is achieved by occasionally interrupting regular work with teamwork assignments; in the modern environment it is achieved by the use of computer networks and the Internet.

An entire methodology can be based on the cooperation of students – emphasising a very important point: *the transformation of the teacher's role*. The teacher has to become a mentor. A mentor does not simply communicate information – but (s)he is also a partner in learning and supports the students on their path in acquiring knowledge, giving them guide in form of orientation and scaffolding to able them in finding what they are looking for in their thirst for knowledge.

2.5 Collaboratories

The definition of this recently created word comes from the concatenation of words “collaboration” and “laboratory”, as World Wide Words defines the concept as follows: “The collaboratory concept has developed in the nineties as a method that may enable researchers to work together on projects even though they might be thousands of miles apart. Using information technology, they would be able to schedule and set up experiments, control instruments remotely, share data, and communicate with each other in a ‘laboratory without walls’.”

Whereas Lunsford & Bruce (2001) described further attributes of collaboratories, attributes that might be used to determine whether something is more or less collaboratory-like (full text cited here):

- *Shared inquiry.* Reflecting its origins in scientific communities, the term collaboratory suggests that participants share not just common goals (say, a party) but a common set of problems or issues--ones that interest them and that they are working together to study more deeply and perhaps to solve.
- *Intentionality.* Although people regularly work together under many circumstances, a collaboratory (as perhaps, collaboration) tends to be recognized by its participants as a joint venture; there is a shared consciousness of the site's status as a mutual project. This awareness can cause it to become a generative space in which each participant appears to gain as much or more than they give. Thus, there is a "tipping point" (Gladwell, 2000), which leads to the critical mass awareness needed before a collective site is perceived by its members as a collaboratory.
- *Active participation and contribution.* A collaboratory exists to the extent that its members use and, more important, add to its resources. Members also continually negotiate with one another over their projects. Often, a collaboratory will contain member profiles to enable further communication and to identify common interests.
- *Access to shared resources.* A collaboratory provides the unique information (data, links, research findings) and tools needed by its participants.
- *Technologies.* Collaboratories involve technologies, whether they are scientific instruments shared by far-flung communities, the unique symbol systems used among participants, or the information technologies needed to communicate. A collaboratory is usually Web based.
- *Boundary-crossings.* Collaboratories bridge gaps and distances of (a) geography, by providing international access through the Internet; (b) time, by supplying both synchronous and asynchronous communication technologies; (c) institutions, by allowing groups access to tools and materials of common interest; and (d) disciplines, by enabling the participants to decide what resources are most relevant to a topic, without regard to traditional understandings of what constitutes a particular discipline.

2.5 Methodology

There is no learning without motivation: it is the most important requirement in the process of education – every teacher knows this for a fact. Still, in case of activities that generate motivation the answer is not so definite. *Acquired motivation* is a fresh and promising psychological and pedagogical construct. Getting to know it and using it may in many aspects renew our pedagogical work. The use of acquired motivation has one fundamental condition: exercises have to possess optimal challenging force. If, during the process, the student does not sense his/her own progress, does not feel that his/her competence is improving, he/she will not be motivated to continue. When organizing a project, this fact has to be taken into account.

Modern visual education is of high importance in schools when forming healthy individuals, since there is a great opportunity to realize a certain wholeness that is often missing, and it is also a good and explicit way to gain practical knowledge on how to form user interfaces and develop communication. Visual communication plays a very important role in ICT applications. Furthermore, there are some who speak of the return of multimedia communication, since giving and receiving information in a number of ways, through several channels, using more than one sense is something that naturally characterizes human nature. Provided that we use interactive multimedia communication well, it can be very effective within virtual learning environments.

Real or virtual communication? Traditional or virtual pedagogy? The answer in the 21st century is naturally *both*. It is obvious that education based on individualized, authentic and highly emotional communication has to remain a part of public education, but using interactive, computer-based materials and by collaborative and co-operative learning the process can also be individualized.

3. Products of the Colabs project – as seen by local educationalists

The objective of CoLabs Minerva project is in absolute harmony with the most recent educational policies: developing an educational environment which is based on co-operation, which uses the opportunities offered by the World Wide Web and which supports discovery techniques in the learning process. The most important idea and aim of the project was to establish international co-operation between pupils based on non-traditional learning methods. In order to achieve this, some educational resources had to be developed based on a special authoring system – Imagine - that could help pupils from different countries to improve their skills and get hold of information in a collaborative way, using the concept of e-learning. Obviously, the obstacles created by language difficulties had to overcome and thus language knowledge can also be expand. That is why the project team identified the learning strategies, developed the objectives for both the pupils and the teachers and improved tools that facilitated such collaboration. Several, quite huge collaborative materials and tool have been developed, on which we elaborate separately. (See descriptions, screen-shots, demos, and interactive elements on Colabs project page: http://matchsz.inf.elte.hu/Colabs/)

3.1 Creative Writing (developed by CNO-PT)

The main goals of "Creative Writing" software was to develop the taste for writing and reading for children of age 5-9, as well as promote collaboration and creativity involving and exercising mental processes that allow to receive, to organize, to elaborate, to retain, to re-cover and to play with the information, through symbols handling, in domains of literacy, citizenship, maths, music and arts within networked class or virtual community.

Conditions: computer with the "Creative Writing" software; activities models to perform with the software; printer (to print all the works and work models to be performed without the computer); paper, pencils/pens and colour pencils/colour markers (for activities without the computer), concerning the fact that most primary schools had poor technical conditions and had only one computer per classroom, which did not allow all children in the classes to use the software.

Possibilities: Children are able to create one page after the other. On every page they can locate a little character and also other predefined objects. If they want to, they can create their own. It is similarly with the background. The program offers some backgrounds to use with which the user is able to modify or create own pictures. Writing is more attractive with the use of some sounds (even own recording), for example spoken words or other interesting sounds. To every page the user can create a special sound and also he can use it for every object on the page (like girl, dog, cat, fridge etc). But in case of using only writing and drawing there are bubbles for every character on the page with some text in it indicating speech. In cases there are pre-made texts that can be also used. But what really captivates the user is the possibility of having a network connection with other users (not just one, but even more). So there is the possibility for children to work together from all over the world, which is really exciting.

The research made under the project consisted of the experimentation of the software with groups of children in different educational environments and aimed, above all: to analyse the “Creative Writing” software’s potential as a spur of the collaborative work in the classroom; to investigate whether the software empowers the development of creativity; to investigate its technical and educational abilities; to obtain feedback for further development of the software application. In order to evaluate “Creative Writing” as a capable instrument in the development of creative and collaborative writing skills, several case studies were carried through in formal school environment and out of school within family groups, in which there were significant differences concerning conditions.

Thanks to the attractive and accessible software tools, children used “Creative Writing” mostly as a drawing tool, neglecting a little its writing abilities. It can be explained by the fact that the first activities were content free. When children worked with an activity model (the introduction of well-known tales), it ran much faster, probably because it was oriented towards a more precise direction. In this case, children did not tend so much to use the software as an image editor program. The fact that “Creative Writing” is equipped with a text-to-speech tool also allowed that children could correct their own writing during the activities. This is an important feature of the application that shall be pointed out, as it can effectively promote the improvement of writing for children.

Observations in the classroom work sessions showed, first of all, children’s relative ease in working with “Creative Writing”. Its functionality is quite intuitive and “transparent”, except those concerning file operations and colour of text/balloon altering. However, teaching those features to one or two small groups per class was enough to reach the whole class. Experimenting with “Creative Writing” educational software allowed the introduction of reformulations/improvements in the application, approaching it even more to the needs felt by the children during its use. Children revealed high motivation to work with the software, and asked for “more computer classes” during the week, and some even asked where they could buy the software since they wanted to work with it at home too.

Concerning the collaborative aspect, we can state that, during the activities, there was collaboration not only between the members of the same group, but also between different groups. Students also organized turns for using the computer. This collaborative behaviour was checked through several gestures such as suggestions, indications, corrections, questions between children, or through dictations. It is also necessary to point out that in all groups there was an un-imposed tasks exchanging, which shows the high definition of the work rules, inside the group, and also reveals the adoption of collaborative strategies.

In informal educational contexts, outside the school, such as the family group and the gifted children, with ideal technical conditions, in which each child could use a computer, we can state that, generally, children prefer to work alone, even when stimulated to work in pairs. Concerning synchronous collaboration developed through different computers in the same classroom, most of the children’s reactions were enthusiastic and some confusion could also be sensed. It was necessary, therefore, to have a very strong leadership so that children could work with rules, avoiding, at the same time, competition and conflict between them.

Regarding creativity, it was not carried out yet a profound analysis of the creative components of the children's work in a school environment. But we can already mention that, based on our observations especially in the sessions in which they worked about well-know tales (Three little Pigs and Little Red Riding Hood) children introduced several changes into the original story. Therefore, and according to the three-dimensional model of intelligence proposed by Guilford, we can consider the existence of divergent productions in the creative process. Some signs of creativity were also evidenced in informal contexts by the gifted children group already using the last software version features, when they introduced some significant changes in the original stories including: characters roles altering, audio-visual illustration, analogies with real situations, fiction, introduction of humour and exaggeration in the developed stories.

Thus, this program can not only offer the teachers an upgrade of their pedagogical skills in their relation with the students, after specific training, but also give parents a closer and richer following of children's learning progresses. As these are simply exploration studies, a lot can still be done and improved in future researches concerning creativity (activity models construction and structured observation grills with well defined describers) and synchronous and asynchronous collaboration. Though the application's features, synchronous collaboration was only used in out-school environments.

We can conclude by research data that Creative Writing is a valid software application that shall be used and integrated in the Portuguese educational system, mainly in the Primary Schools (KS 1 & 2). With this application, students can improve their writing expression abilities, develop collaboration strategies between pairs and empower their creativity in carrying out several works in different subjects such as Portuguese Language, Mathematics, Global Studies, Project and Communication and Information Technologies (this last one, mainly in KS2 e KS3).

3.2 Fractions (developed by CUB-SK,ELTE-HU,LOG-UK)

One of the most difficult parts of the subject of mathematics at a low level in primary school is unquestionably fractions. The juniors find hard especially to handle the basic mathematic operations with fractions. The aim of creating the program "Fractions" was to give to children a tool that is able to visualize fractions. The other thing was to establish in children's mind a clear idea about fractions, what they are for, how good they are and what kind of problems we can solve by using fractions. Basically to give them opportunity to play with fractions, investigate them and by this investigation create their own ideas about the use of fractions.

Because of these reasons there are many possibilities in Fractions tool set for different representation of fractions. There are examples from the easiest ones like pies or chocolates then a bit more mathematics like decimal number, percentage, fraction, ratio and a number on the number line. The most attractive representations are made from various pictures and group of pictures. In these the user is able to create own pictures. Also there is a possibility to change every component's size, colour or other attributes. The user can also use own backgrounds from picture file for a particular page or by using the drawing tool to draw own pictures. For a certain component the user (usually teacher) is able to change the various additional properties, like:

- to enable/disable the possibility of changing the attributes for a component (if disabled then children can use the component, but not able to make any changes in it)
- to anchor component which means that the children are not able to move it
- to hide some component so the children can not see it
- to enable to show the fraction as a mixed number or in its basic form

One of the strongest features of this program is the possibility of making one component dependant on the other component. For example if we create a pie component and we make it dependant on previously created percentage component then 50% will be shown as one half of the pie. When we change the number of the percentage, the pie component will be automatically changed to the relevant form.

Other features are operators (arithmetic and comparative), evaluation components, defining areas, generators and text fields. By using these features the teacher is able to create various activities or even a whole set of activities in one page. By creating more then one page of activities the teacher is able to produce a book. Within a book the user is able to add, delete, move, copy, paste and save the activities.

In principle the user has two choices how to use this environment. On the one hand he is able to investigate how particular enabled features are changing, what kind of relations are between them etc. The teacher in this case prepares the activities. On the other hand pupils can solve the prepared tasks and they will have them interactively assessed. There are several tutorials made for this program. They are made (similarly as the program itself) in several languages and are very helpful in order to learn to use the program. The whole program is really user friendly.

In summary: if we think about the application of this program we can see many possibilities especially in the cooperation of children and mutual learning. For example one child can prepare a task for the others or eventually everybody can prepare an activity for the others. All of them have the same tool to do it, but naturally they prepare different tasks. And it is more exciting if you have to prepare a task for your classmates. This will save much time also for the teacher, because he will only have to coordinate the whole process of learning. And additionally children will find out that mathematics is the same in the whole world. The designers have carefully examined curricula of several European countries to make sure that it fits into all of them. In general the program “Fractions” is an astonishing tool, which you definitely will use if you are a teacher. And obviously children will like it very much.

3.3 Colabs Portal (developed by ELTE-HU)

The first step was the creation of the distance learning support infra-structure, CoLabs portal, and the creation of tools that allowed and provoked the exploration and learning by the children using Imagine microworlds. The developers researched a model of e-learning platform and produced active web materials that provoke children, teachers, tutors and parents to act collaboratively on a networked learning environment.

The designers wanted to teach children aged between 9-14, how to use Imagine and become familiar with this environment. Because of this reason there are several simple games (microworlds) on the website which users are able to try and play with. Beside this there is an online Imagine course for children. Activities are focused on the development of small games, projects and stories that allow children to learn how to work with Imagine while building stimulating projects. During these activities, the existing tools in the portal (web chat and forums) were used by the children to collaborate while learning to use Imagine and in the production of their essays in the project area. This philosophy is highly effected by Logo philosophy, by developing open microworlds that can be configured and re-designed by learners themselves to produce their own models during the learning process and be able to master the basics of using the Imagine tool for expressing themselves and acquiring digital literacy, modes of communication and media competency.

As for other possibilities for the portal, visitors are to join in some kind of pedagogical and educational activities. There are many small projects that can be played straight through internet. These projects usually have some output in form of a picture. The user can upload his pictures to the forums, so every visitor will see their work and can make some comments on it. They can suggest how to continue work, what kinds of changes might needed and how to make it better or different. Basically through these forums interaction can develop between the visitors of the website. In some way it is a kind of chat through the Colabs portal, which is very popular among youngsters nowadays.

Language is of course a big problem. Children are obviously not able to communicate with every member of the portal, because they know only their own mother tongue. Usually the case was that they commented only the pictures of their compatriots. But the portal is prepared to give opportunity also for learning another language. There are some projects designed especially for this, like “Cards” and the huge “Encyclopedia” which is made in several languages. It is basically a dictionary of the most used words in every language.

Multilingual communication was one of the principal goals of the whole project. Some further aids and tools have been developed in order to support such communication and collaboration:

Networking projects (developed by CUB-SK): Within the Colabs portal several networking activities were designed for pupils at the primary level. They can play together various well-known games, e.g. *Memory game, Ludo, Five in row, Cards and Painting*. All these networking games are designed to make a significant development in children’s cooperation and collaboration.

Networking tutorial (developed by CUB-SK): This tutorial is designed for users of Imagine as authoring tool. It gives users an illustrative demonstration of how to communicate in real time through the network in the environment of Imagine. The reader will find out how to,

- send and receive messages through Imagine
- send commands and execute received commands
- find IP address of a remote computer
- connect not only two but even more computers at the same time.

Translator (developed by CUB-SK): This program is designed for developers of Imagine projects in order to share projects written in different language versions of Imagine by translating the whole program from one language to another. There are obviously several difficulties in this kind of translation. Basically it is technically impossible to have 100% correct translation. Even with this we can consider that the Translator is a strong tool for translating the written programs. It makes the possibility of cooperation even wider and far over the limits of the language made boundaries.

As overall collaboration, the site is configured to hold activities and functionalities in several languages, thus the user can choose to use the language well understood. There are of course different levels for exchanging ideas:

- at basic communication level (based on the common written language) e.g. in *Brainstorming*;
- at picture communication level (through iconic language) e.g. *Word wide encyclopaedia*, *Telling you in pictures* authoring tool;
- at expression level (based on products created using given tools) e.g. Creative tools;
- at add-on level (based on extension or modification of special features) e.g. uploading and downloading new features;
- at authoring level (based on communication through Imagine scrip) e.g. exchange games;
- at networking level (connecting users synchronously) e.g. networking *paint* tool.

Evaluation: The use of the Imagine course proved to be very effective within normal classroom settings in present school situations and has produced a very effective multiplying effect in teacher education definitely in which the whole project could be integrated very smoothly and productively. Further activities are aimed to serve not so much in-class activities, but rather after school activities where action of students should depend on their motivation and interest and not assigned tasks (as defined in school work). Nevertheless, our local experiments did not manage to provide such environments as schools could only provide access to portal during in-class activities and in most cases (due to technical problems) with quite low network access. Thus, we can say, that although all participants declared that such environment provide gorgeous opportunities for effective collaborations, we could not provide enough evidence of this and are already involved in some follow-up activities to prove this result.

Concerning the collaborative process aspects, the direct observations have shown the potential of the authoring tool “Imagine” as a stimulus for collaborative learning and an important motivation feature. An increase of the children’s enthusiasm in the activities’ concreteness was verified when they began “controlling” those activities. This fact reveals the good choice of Imagine as the portal’s authoring tool. Examination of the web chat interactions registered and the direct observations held have shown that, as soon as the collaborative supported function was understood, the students felt comfortable changing roles and tutoring their peers. The classroom environment was full of excitement and motivation to explore and discover new things.

Regarding the tools’ application aspects, the majority of the users have not shown any kind of difficulty in the use of the portal itself, feeling pretty comfortable in its exploration. The users were also very at ease using the web chat, as many of them were familiarized with the MSN Messenger application. The users understood rapidly the several available tools functioning, demonstrating fluency in their use. The quantity of web chat rooms created by the students is a clear example of this. Some users have exploited easily the forum system, though the majority of the users did not quite understood the differences between the forum and the web chat, preferring the second one, as it could be used in real time. Access speed of the portal has not allowed easily the use of the area “My works”, that might have been fundamental to the files share, that could have permitted another kind of relationships.

In general, the available tools in the portal are easily employed by the users and they explored it very comfortably. Many of them have expressed their opinion saying that the portal and the microworlds have great quality. The motivation for the use of new tools (especially Imagine and the web chat system) was very high. This was expressed by the number of times the students have asked the availability of Imagine and the teachers' opinion that this had been a very stimulating project for the students. The major difficulties experienced were not directly connected to the use of the portal itself, but to the technical conditions required to do it, namely the Internet access available in schools.

Concluding, the CoLabs portal has constituted a useful instrument for the teacher in the collaborative learning implementation in different contexts and as a learning and creativity exploration place. The pedagogical value of the portal is based on two fundamental potentialities: as an information source and as a work environment able to promote and assist the on-line collaboration (synchronous and asynchronous) and in scholar context (classroom) especially in Key Stage 3, in the Areas of Project and Information and Communication Technologies and their parallel in alternative national curricula.

3.4 Secondary maths (developed by OEIiZK-PL)

Five "mathematical microworlds" addressed to the students aged 12 to 18 were designed and verified in practice under the Colabs project. The microworlds allow and facilitate active learning of chosen areas of mathematics by students' own intellectual activity: their own explorations and trials. Each microworld is accompanied by materials and directions for the students as well as comments designed for the teacher.

Polygons: This microworld deals with the topics which appear both at primary school and at the further stages of the educational process. Its design allows it to be used with students of very different ages and levels of mathematical competence, beginning with grades 4-6. Working in the microworld a student can construct various polygons and explore their properties. They can make geometrical experiments not only on the "synthetic" properties of the shapes but also on the lengths of segments, angle measures and areas of polygons. Based on these experiments they can construct their knowledge. In the process they become acquainted with important mental operations such as generalisation, specification or reasoning by analogy, and learn to use them. The microworld is a tool for discovering and purposeful exploring the consequences of the changes made either in the parameters of a single shape of in a more complex shape structure. The student him/herself can define their area of interest and independently pose research problems relevant to them. The use of square grid as a tool for settling questions about the properties of the shapes under examination allows students to give reasons and develop argumentation.

Doing geometry, or maths in general, by experimenting has immense educational value, however, it calls for caution. This empirical approach should be reasonably balanced with building the right intuitions and geometrical correctness. It is therefore necessary to generate such situations, problems and questions, which unite both aspects. A large part of the activities offered by the microworld fulfils this requirement but some need modifying.

Vectors: This microworld allows the students to carry out rich experiments on vectors and to build intuitions of the concept. It gives them an opportunity to get acquainted with different representations of vectors, further develop their skills connected with system (systems) of co-ordinates, and to gain a better understanding of a physical sense of vectors as well as the relations of the basic physical variables (velocity, force etc.) and the laws that govern them. Working with the microworld often becomes an involving play, for example at “space travel” and „hues composing”.

Experiments and exercises presented in the microworld enrich students’ experience, give them an opportunity to formulate and verify hypotheses, to make generalisations, in other words: to mathematical and physical creativity. The level of complexity of the microworld allows it to be used effectively at both middle and upper secondary school.

The laboratory of randomness: The topic of randomness is on one hand very important, not least because of its manifold practical applications, on the other quite difficult. This difficulty arises partly from the way in which probability is taught at school. At the lower stages of education elements of it appear sporadically and at higher levels teachers and the authors of curricula and textbooks often escape into mathematical formalism difficult for students. What such an approach lacks is awaking a wider scale “probabilistic awareness” in children, as well as early enough and consistent development of the right probabilistic intuitions.

The Laboratory of Randomness consists of a series of “probabilistic projects” showing different areas or aspects of randomness. Students’ own activity takes them all the way from probabilistic experiments and experimental frequencies to theoretical models such as e.g. Engel’s diagrams, which yield a better and more accurate description of the phenomena. Following this way is necessary for good understanding of the nature of randomness. The projects offered in the microworld go quite deep (sometimes very deep indeed) into randomness, touching important and difficult probabilistic concepts (random variable, its distribution, mean, etc.). The authors apply different tools including Logo procedure definitions, which undoubtedly enrich the offer, although, as they admit themselves, does not necessarily make it any simpler.

Game algebra: The role of games in mathematical education cannot be stressed enough. Games motivate, give an opportunity to carry out various important mathematical exercises in a pleasant setting, they can provide a realistic context for doing maths. Games offered in this microworld are certainly involving, especially for people who like this kind of intellectual activity and its challenges. They allow the students to discover patterns, to purposefully develop local strategies, to see analogies and symmetries. Even the very stage of exploring those games is mathematically educational.

The idea of applying games in order to make students familiar with elements of algebra (sets of equations, Gauss procedure etc.) and to show them their usefulness, for example for constructing global winning strategies is original and interesting. At the same time, however, the microworld poses a difficult challenge for a student. Even the activity of consistent search for a winning strategy is quite foreign to an average person. The tools used in the project, e.g. arithmetic modulo 2, create additional difficulties. There seems to be a need to supplement the games with more examples in which the level of abstraction and difficulty rises more gently and gradually.

Visual Modelling: The main goal of this microworld is learning the art of problem solving. In some of the problems presented a solution would not be possible at all without a computer. A computer also allows conscious and consistent application of the trial and error approach, or rather trial and correction, which is one of the most powerful and most natural tools of problem solving. While struggling with problems, which are very attractive visually, or even border on artistic, a student gets the opportunity to apply their knowledge and to deepen their understanding of mathematical ideas. They learn to translate what they see into mathematics, and discover the usefulness of e.g. trigonometry. This kind of situation can motivate students far better than traditional activities of the teacher.

The problems presented are rich and mathematically varied: they involve circle geometry, trigonometry, various properties of shapes, the ideas of recurrence and randomness. They are also quite compelling. As a result students merely apply the knowledge they already have rather than generating it during the problem solving; this, however, might have been the author’s intention.

Evaluation: We have forgotten about an old and frequently repeated truth that true progress in education can be achieved not by changes in curricula or school types but only by perfecting the methods of work with children. Meanwhile the successive waves of reform barely touched the teacher training system. It can also be assumed that, in spite of plans and efforts to do so, they did not change the educational philosophy of teachers either. This is, as practice shows, usually very traditional, based on behaviouristic principles, according to which the teacher is the “dispenser of wisdom” and the central figure of the learning process. Schools still prefer, regardless of the student’s age, explicit instruction and concentrates on exacting the knowledge. Perhaps the reason of this state of affairs is the fact that a large part of the population including teachers is completely unaware that the learning process can and indeed should take a different course.

The Colabs project shows what a modern educational process (in which a student gets a chance to gain real knowledge) can look like and how modern technology can be used to change traditional methods of teaching and learning mathematics. The microworlds present mathematics as an empirical (or quasi-empirical) science close to the vision of I. Lakatos, its only difference from e.g. physics being the nature of objects on which the experiments are conducted. In mathematics these are numbers, shapes, events, games. With such an approach mathematical creativity comes naturally: experimenting is followed by hypotheses, their verification, examples and counterexamples. The students are intellectually active, in the zone of their proximal development, they co-create their knowledge in the process of communicating and co-operating with others. Not only content is important but also strategies of acting in various situations. Motivation for studying is increased and the students become ready to learn all their lives long. The project shows exactly this educational style, which should be adopted by as many teachers as possible as soon as possible. Attempts to use microworlds at school look very promising.

3.5 Conclusion of internal evaluation

A great deal of work, much of excellent quality has been achieved by the project. In particular, the work done by the CUB-SK & ELTE-HU groups on both The 'Fractions Microworld' and The 'Creative Communication' Portal have been quite outstanding, in terms of their quality, the commitment of the researchers and the exciting pedagogical potential of the outcomes.

The work done by CNO-PT on the communications API and Creative Writing Exploratorium has been well executed from a technical viewpoint, but lacks the pedagogical refinement related to practical classroom management and applicability. It is likely that these problems can be overcome by further work, but this will now lie outside of the project.

The Secondary Maths Microworlds done by OEIiZK-PL have been finally completed, although the delay in finishing the work has unfortunately restricted the amount of time the materials have been able to be trialled in schools with teachers. This is a pity. It is unlikely that this outcome has potential for free standing commercial exploitation, although it may be possible for these materials to be adapted to be of use to teachers as a component of a larger resource with some further work.

The Translator Microworld by CUB-SK has been another excellent outcome, and has allowed all participating partners to rapidly translate and share prototype work done in their own native language with project partners in other countries. This has enhanced the project considerably, since even with such a short time-scale much work has transferred between partners through their own schools and teachers. This Translator Microworld has been a very valuable tool which should be maintained and further developed for the benefit of the user community (if at all possible) after the close of the project.

Several important products have been developed during the project that filled the gaps in education, met the needs and conditions of different education systems and could be utilised in institutions for public education. The main achievements of the project were the encouragement and spreading of new pedagogical methods and learning habits suitable for the 21st century. The project activities caught the attention of those innovative teachers who are open to new ideas and who are suitable for adapting and further spreading the products of the project available.

4. Discussion

With the inflexible syllabus and the 45 minute lessons in school *it is difficult to utilize all products of Colabs project according to its original objectives*. It is not the learning environment that is at fault. The learning group's inflexible structure and the technical equipment that was often out-of-order frequently caused the students in cases not to feel that this was an ideal challenge.

The developed collaborative environment can have an immediate effect on education! Although the process of teaching is still greatly determined by technical conditions, advance of ICT is undoubtedly making headway in schools. This is why those environments where constructive teaching, discovery techniques, and pupils' creative thinking can be developed are important in primary and secondary education. The problems that occur and the experience gained during their application must be thought over in order to move forward so that new educational frameworks can be developed. There are two main elements of the learning process that are important here:

- Constructive learning
- Cooperative learning

While constructive learning is an internal process and as such, it builds upon the use of mental strategies, cooperative learning is an external, environmental process that is based on social interaction and it requires cooperative strategies. Learning is effective only if both of these elements are well organized, and a suitable methodology, a proper technique and an appropriate mentor is available. It is an interesting coincidence that the mental processes and patterns that are developed during the improvement of the problem solving ability support and make more efficient both constructive and cooperative learning. Those children, who learn to model the problems, have patterns to solve them, perform better both when they learn by themselves or in a team. So efforts spent on improving this ability is good investment, is worth to stress on.

4.1. Problem solving ability

There is no “sterile” module for the improvement of the problem solving ability in the sense as if it would have been made for the convergent/divergent method (Turcsányi-Szabó, 1998). However, almost all of the microworlds require, in different depths and different forms, the kind of thinking that can be improved using convergent/divergent methods. Colabs - by its nature - primarily focuses on direct manipulative activities, but in almost all cases the need to break up the problem into smaller parts is present. The microworlds in themselves are basically exemplifying the convergent method, like the “Experimental Picture” (where a picture is to be composed of rectangles, triangles, circles and half-circles) or the “Procedure Pattern” where the object is to make a picture using the procedure-pattern and the tools.

Visual problem solving is one of the most important forms of problem solving and it can be improved in a spectacular way by using the multimedia-equipped Logo programming environment: Imagine. The most tangible application of visual problem solving it to put the problem into a graphical form that can be approached in a way that is easy to understand, feels natural and is intuitive – yet at the same time it is analogous with the abstract way of solving the problem so it clearly has a transfer effect. Thus the developed tools and microworlds provide excellent environment for problem solving on different domains, let that be story composition, manipulation with elements of fractions, picture communication or any other expressive form of art production, modelling or experimenting with higher mathematical ideas.

4.2. Visual communication

Every day we need to take in more and more information the majority of which is visual. May it be a simple sign or an electronically created picture, visual messages have more and more important roles in the flow of information: its understanding and everyday use have become integral part of our lives. Students therefore need to be taught how to ‘read’ these graphical, typographical data and how to create new ones themselves. The main point of *communication* is that the message is transmitted (through a channel) from the sender to the receiver. Information has to be coded to become a message that is de-coded by the receiver. Every successful communicative act depends on whether the receiver understands the message or not. The message in this case is a picture, a sign, an image, and so it is the virtual effect that has to grab the receiver’s attention. The aim of visual communication is to transmit the heterogenic, compound world into a picture message so that it can be de-coded by the one who gets it.

Drawing is none other than fixing thoughts, arguments and experience into pictures. For children it is a natural means of communication, through it inner processes and feelings are shown. The advantage of drawing is that it does not require such high level of abstraction as speaking. In teaching how to draw and design with the help of a computer, the fact that children like the device and are familiar with it is a huge advantage. Speed is also very useful given the relatively short art lessons: one can combine, design, plan, change and experiment a great deal more. Moreover, the steps of drawing, colouring and planning are all reversible and thus can be corrected, and new ideas are more easily realized.

Thus the form of picture communication should be a very straightforward act for children in grasping the idea of transmitting information and acquiring new words of foreign languages, while the context of collaboration in itself is the motivating power. Besides, creating stories using pictures, text, multimedia elements develops creativity and encourages the understanding and further share of each others culture. In Fractions, the visually tangible user interface provides a truly tangible environment to touch and play with, creating different forms and shapes to explore depending on configurations needed. And in Secondary Maths, the difficulties of abstract modelling are overcome by placing the context of learning into highly visual surroundings, namely in cases artistic works.

4.3. Motivation

It is clear for every educator that motivation is essential for learning. Only motivated students and motivational education systems will become successful. From a psychological and pedagogical point of view, however, we know much less of motivation, its systems and its developing possibilities.

Learning and experience become connected in motivation and the opposite is also true: motivation is engraved in the process of learning and teaching. Since the two are in strong interactive relation, a child's motivational and cognitive development cannot be separated. The educational process itself, as one of the factors that affect learning, has to be organized in a way that it explores, uses, develops and builds upon (or, if necessary, corrects) the students' already existing motivational system. This applies, naturally, when motivation is both a goal and an instrument of education. It is a goal to reach in a sense that it serves self-development, and it is certainly an instrument when we use it as the base to build new knowledge upon. Thus, learning motivation affects the educational process both as a condition and an outcome.

The cognitive process has a rewarding and motivating nature of its own, due to the sense of success and the pleasure it brings. Self-rewarding motivation is a drive to start and continue an activity for the sake of it and for the pleasure it gives rather than for reaching some kind of a goal. This also means that we do not have to reward an activity that is rewarding in itself. Reward coming from outside the self can discourage a child to enjoy his/her activities just for themselves and can block motivation.

Acquiremental motivation drives the self to learn and practice a new skill or ability, where the motif works until the secureness of knowledge appears. The pleasure of learning something new increases motivation. The minimal insecurity in the possibility of reaching the goal gives acquiremental motivation its key element: it separates motivation from competency and the simple attainment of a goal. As such, it only works when the activity and the goal have optimal challenging force. (Józsa, 2000, 2002.)

First years in school are of high importance in the formation of children's learning motivation. If in their studies they fail to experience the pleasure of learning and gaining knowledge, learning motivation is not strengthened and affirmed. This way, the motives of learning motivation give their place to other kinds of motivation not connected with learning. In many cases, kids' self-rewarding motivation only works in situations outside the school.

Comparing oneself to others and the role of companionship becomes more important in schools. The system of motives is also influenced by the child's social competence.

In many cases, as children grow and gain experience in school, motivation for learning and for the pleasure of acquirement decreases. Research outcomes in Hungary show that as the number of years spent in school grow, motivation (even within a school year, as longitudinal experiments suggest) gradually descends.

Activities within the Colabs portal provide constantly renewing experiences that can be highly self-rewarding and provide pleasure in further explorations and collaborations. Thus it is highly advised to be used as out of class activity, allowing the child to have free access to environment to contribute when the urge and thought is ripe to take the next step and keep doing so as long as motivation is high in order to achieve effective development. The same case can hold for Creative Writing as proved by family group experiments. While Fractions and Imagine course material are more task oriented and could suit school work very well. In case of Secondary Maths it is a more sensitive issue, since classes are very much curriculum oriented to be able to achieve requirements formulated by the government, thus teachers feel less flexible in applying more fee style explorations in school work.

4.4. Creativity

Creativity is a unique, original creative process, the focal point of human talent. In modern psychology, creativity's exploration has become a major movement in the sixties. *Torrance* writes about several creative abilities in his books and he was the one to create the most famous and popular creativity test of all. (1969.) He created seven verbal and three visual exercises for kids who can already express themselves in writing. Another line of research is marked by the name of *Guilford* (1967.), who says that creativity's most reliable sign is the ability of divergent thinking. This is most obvious in the completion of tasks were there are more than one ways to solve a problem and give an answer. Guilford's creativity tests measure four classic types of creative skills: fluency, flexibility, originality and elaboration.

Fluency and flexibility can be developed and taught during the school years with the right exercises. We have to create situations where children get a chance to explain their ideas freely, without being evaluated in any way. Originality is a given characteristic in every single child at the beginning of kindergarten, since their knowledge of stereotypes is rather poor. It is obvious and quite inevitable that this changes as the child learns patterns and rules of thinking. However, this change should not necessarily mean that after a while the individual desperately holds on to only one stereotype. Though originality can only be taught by educators that are themselves original, it is possible to facilitate (or, unfortunately, block) its development (Davis and Rimm, 1994).

There are many other intellectual abilities apart from these that play a part in the growth of creative potential. From the research's point of view, we found problem-realization, problem-definition and visualization the most important. The latter is the gift of imagination and fantasy, the ability to see things with the "mind's eye" and manipulate pictures, images and ideas mentally. (Davis and Rimm, 1994). Certain characteristics, such as sense of humour, curiosity, artistic interests and talent, spontaneity and some others, can also be regarded as creative capacities.

To put it another way, a child's intelligence can be developed by making him/her use what is already learnt. To develop creativity, on the other hand, a great deal of individual creation and work is needed. Children need to work on a creative activity that's outcome is known, but we should not determine the way or method with the help of which they reach that outcome. They should be free to recognize the possibilities and realizations in order to reach their goals.

Creative personalities tend to be rather self-confident, as well as independent, energetic, adventurous, curious, playful, witty and sensitive. Often they are characterized by artistic and aesthetic interest and are fascinated by complex and mysterious things. Most creative characteristics can be developed. If, for instance, we strengthen one's self-confidence by reflections and positive reactions, his/her creative productivity will probably increase. This is especially important between the ages of 10 and 14, thus the teacher's responsibility is huge.

The tools introduced here are all in themselves and in combination ideal in providing cradles for creative thoughts and emergence of individual ideas. Allowed to apply with the needed freedom and the possible guidance needed, they can certainly contribute to the development of creativity both in individual and in group work.

5. Conclusions

"The project provides materials for nurseries, primary and secondary schools that utilize alternative methods and want to integrate collaboration into their teaching-learning process in various areas." The project's aim is to develop tools supporting collaborative learning on the Internet utilizing Imagine as authoring tool. The project investigates that what kind of support do children need to get into even international level of collaborative learning and thus intends to develop the framework and the materials needed for this. Basically the project seeks answers to the following questions:

- With whom should the children learn?
- How should they learn?
- What should they learn?
- How should the children be supported in learning?

With whom should the children learn?: Global connectedness makes possible new types of `knowledge-building communities' in which children around Europe and beyond collaborate on projects and learn from one another through distributed learning with guidance if needed from elder contributors (adults, teachers, or mentors). The multicultural and multilingual nature of the Internet provides valuable additions to the work, learning and communication.

How should the children learn?: It should be clear from the previous how digital technologies can enable more active and independent learning. The Colabs project works along this concept when it designs tools and activities that have at their heart collaborative construction supported by what is called the active web. These tools and activities enable students to take charge of their own learning, through direct exploration, expression, and communication with others through constructivist methodology.

What should children learn?: For the sake of improvement of basic skills modes of self-expression, communication of ideas, and the development of collaborative model building should be investigated and evaluated in a variety of domains in order to broaden the scope of children as much as possible. Materials developed through the project provide enough guidelines for teachers and developers in producing a multiplier effect for further production of such microworlds on different domains.

How should the children be supported?: Extensive and adaptive course materials, on-line aids and help forms, peer support, and adult mentoring should aid children in their virtual work, while parents, teachers, caretakers should provide direct guidance in real life activities forming a supplementing whole community as environment for secure self-development.

In the end, the goal is that children living at any location and within any culture succeed in mastering not only skills for use of basic ICT, but also developing fluency for expressing oneself with the tools, learn basic competencies using innovative tools (Imagine) and methods (Logo philosophy), while basing their advancement on communication that, with the help of the Internet, can even cross borders. Another important goal is to provide methodology and tools tailored to the needs of children, and to support teachers to learn using, configuring, and even creating smaller collaborative microworlds themselves according to needs. And last, not least, the network developed during the project should have a broad scale of uses in the area of distributed learning, involving more disciplines and cultures and thus invoke changes in the role of the teacher in modern education.

Nevertheless, a quite common exclamation emerging from present school practices:

“Our societies are not yet ready for such collaboration.
We have to do our best to make it work!”

Such practices, tools and methodologies have to be integrated right away into present teacher training practices and in-service teacher training. Further more these initiatives have to be introduced to public education as soon as possible with the provision of direct help to learners and teachers to produce the best effect on the learning process and to change present practices as soon as possible.

The future of Colabs

The first phase of Colabs is coming to an end and it is time to think about the future of the project. Pedagogical, professional and, of course, financial questions have to be answered. It is for sure, that the project will live on.

The Fractions microworld has already been launched for sale at BETT in UK, the Creative Writing microworld’s journey on the same road is just under consideration, Imagine course grows itself to become Creative Classroom on CD, while Secondary Maths is right on the web for immediate use. The portal and its interface will be constantly re-developed with new projects launched through experiments and hopefully the activity of the users will turn into a self-generating activity curve invoking true collaboration and added development.

At this time, Colabs was not introduced to the students in the most ideal way, as they have mostly encountered it in the school, in the classroom. The ideal situation would be if the portal could work without any school “enforcement”, just as a result of personal motivation in free time. The next step should be collaborations forming purely on the Internet with widespread use.

Some day, perhaps it will be natural if a Brazilian student asks help from his Slovak fellow to solve a problem of a project development in Imagine that originates from a Hungarian child…

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