A Collaboration of ICT teacher training and primary school for special educational need children in Hungary

Brigitta Réthey-Prikkel, *rpb@ludens.elte.hu*
Dept. of Media & Educational Technology, ELTE University, Hungary

Márta Turcsányi-Szabó, *turcsanyine@ludens.elte.hu*
Dept. of Media & Educational Technology, ELTE University, Hungary

Abstract

In ELTE teacher training the Dept. of Media & Educational Technology (previously TeaM lab) provides courses since more than 10 years now as non-compulsory electives, with relation to developing e-learning materials and running projects in public education, where students develop programs for different curriculum areas, take them out for use in schools and prepare a report about their effects in classes, suggesting some areas of possible modifications for improvement.

There is an active collaboration between ELTE Bárczi Gusztáv Practice Elementary School and Methodological Centre for Special Education and TeaM lab since 2003 to develop ICT tools supporting their pedagogical program and hold experiments to evaluate their effective use.

The paper discusses the specialities of designing tools for special educational need and requirements forced on the developed programs that emerge from practical experiences. The development process is analysed as well as the formal evaluation.

Keywords

ICT, game design, children with special needs

The binding situation

ELTE teacher training specialties

TeaM Lab has been established in the beginning of 1997 under the leadership of Márta Turcsányi-Szabó with founding membership of students. TeaM Lab (Teaching with Multimedia) operated at the Faculty of Informatics and served mainly Informatics teacher training undergraduate and graduate programs. TeaM lab provides courses within ELTE teacher training as non-compulsory electives, with relation to developing e-learning materials and running projects in public education. TeaM Lab concentrates on convert as many courses as possible to productive project work developing products serving public education (from kindergarten to end of elementary school, with is grade 8 in Hungary). In this model students develop educational software for different curriculum areas, introduce them in to schoolwork and prepare a report about their effects in classes, suggesting some areas of possible improvements (Turcsányi-Szabó, 2006c). The following are among the courses:

- ***ICT in basic education***: Analysis and methodological evaluation of ICT use in the full scope of kindergarten, elementary and lower secondary education. Designing collaborative e-learning projects for launch in the coming semester.
- ***Web animation***: Mastering all aspects of web animation for use in web sites and simulation programs. Designing web animations with Adobe Flash for different educational purposes.
- ***Authoring tools in basic education***: For many years we used *Comenius Logo*, but since 2001 we use *Imagine* authoring tool. Students developed modelling assignments for different disciplines practicing constructivist pedagogy.
- **Evaluation of educational software:** Formative evaluation and pedagogic evaluation of software (usually developed by other students in previous years), by analyzing the National Curriculum and teaching strategies in order to define a hypothesis for pinpointing the scope of development, designing activity to go through the process, and composing pre- and post test to prove the presumed hypothesis.
- **Designing educational software:** Students develop complex educational software (using Flash or Imagine) to be used in different disciplines practicing experiential and constructivist pedagogy on a specific focused area.

In this process students experience and master innovative technology and methodologies, contribute with their own developments through active participation in an ongoing project, which are then directly implemented and mentored within public education. These ongoing e-learning projects transfer innovation into public education with a short cut, which is then evaluated through research analysis involving Ph.D. students to gain further knowledge for future projects and developments. (Turcsányi-Szabó, 2006c).

ELTE special education school

ELTE Bárczi Gusztáv Practice Elementary School and Methodological Centre for Special Education is a place for special educational need (SEN) teacher training practice, and also it is a school for children with SEN. The school engages children with learning difficulties, where they can learn to read and write with dyslexia and dyscalculia prevention methods, which assures the individual improvement of each child and makes an effort to exclude the usual failures, and try to assure continuous development of skills and abilities within all classes and after class activities. For this they use generative activities (for attention, memory, orientation in space and time, motion development and motion skills), speech therapies, habilitation and rehabilitation sessions and therapies, drama, ICT, journalism, household management, needlework, swimming, table-tennis, singing, playing on the piano and the flute.

For best results teachers work in teams and individually for children's special needs. They use different methods and techniques with a lot of functional examples, practice, experiments and demonstrations. They try to concentrate on child's abilities and find the way how that child can find a way to be able to master the curricula.

The curriculum for special needs schools in Hungary

Because of the special needs of the pupils, the school's curriculum is different from that of the usual. Here pupils need much more learning time than most children and they are definitely granted extra time. The Hungarian National Curriculum (NAT, 2003) emphasises the following within the general issues of obligatory schooling for handicapped children's training and teaching:

„In case of pupils with special educational needs, the following primary principles must be applied, while being adjusted to individual needs and limitations:

- Extended time periods must be given to accomplishing tasks, as needed;
- If necessary, special content and requirements must be developed and used in accordance with the nature of their disability;
- Schools must use positive discrimination and differentiation with these pupils, providing them with individual help and assess them mainly on the basis of development in light of their condition.

The special tasks required in case of certain disabilities are governed by the guidelines for the curriculum of pupils with special needs as well as examination regulations." (NAT, 2003)

The Hungarian curriculum for special needs children suggests that children with learning difficulties needs two years in order to master the materials defined in first grade, and for the first two grades material three years are suggested, while the schools are free to decide about the terms of progress. Teachers in schools pay attention to the development of each pupil, but the local curriculum does not suggest any further requirements.

For the above reasons, we can only calculate with as much as the maximum of expectations, but always have to have in mind, that classes are usually far behind the expected curriculum, which can also be the case with normal children. Nevertheless, classes often lag behind the suggested timing and would be able to fulfil tasks suggested within 6 years of schooling only within the time frame of 8 years. It cannot be predicted how far children can get in development of their skills, abilities and knowledge.

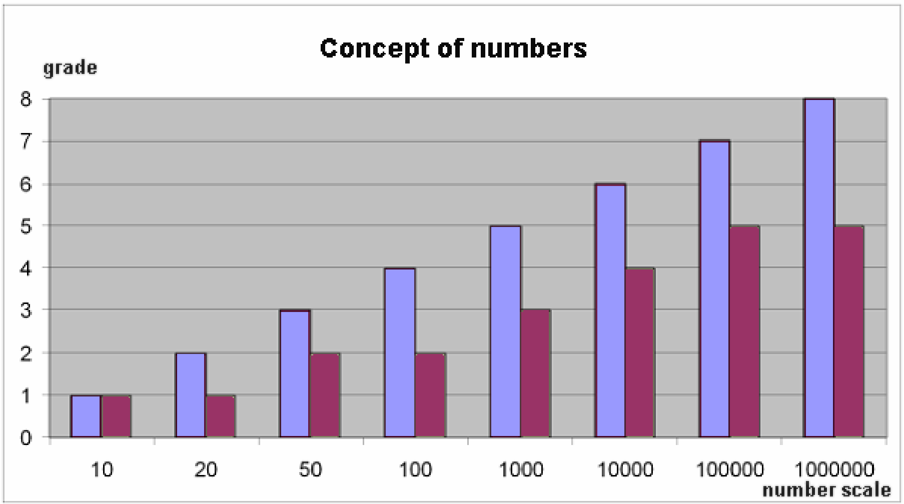

Figure 1. Difference in levels of achievement (in terms of grade) in normal and special schools within different subject areas, based on data available (NAT 2003). (Blue is the schools with learning difficulties, and purple is normal school)

Our collaboration

When the GYFK (Bárczi Gusztáv Faculty of Special Education) became a part of ELTE the primary school also became a part of it. At this time the leader of the school Éva Papházy got into contact with the Faculty of Informatics to ask for in constructing ICT tools for their speared teaching and learning process with their pupils. By now there is established an active collaboration between Bárczi School and TeaM lab since 2003 to develop ICT tools supporting special pedagogical programs and administrating experiments to evaluate their effective use.

Before we started working together the school has tried out different software within their classes and just kept a handful of them, since the rest did not suit their special needs. Some programs they tried out were developed for normal educational needs and for this reason it was not suitable for this special need. Other programs were developed for SEN children, but were not Hungarian, what made it impossible to be used. Not to be able to us their mother tongue is only one reason why these programs were not suitable for this schools needs, but a more important reason is, that reading and writing difficulties are different in every languages. (Nunes, Bryant, 204) That means every language has different characteristic with grammatical rules and vocabulary, what makes that not only programs, but also books and tests cannot be used by translating them from word to word, so such learning material and helping tool have to be created from scratch in every country.

After our established relationship, they provided us with a list of ideas they could use in their developmental work and suggestions for modification of software they have encountered so far. At the same time we prepared for them some skill building programs, which we thought would suit their needs.

Children have now different classes taking place in the computer room. Classes have one or two Hungarian language lessons and mathematics lessons in the computer room every week now. For example for the fifth grades mathematics curriculum 36% of the topics are covered by different programs. A big part of these programs were developed from ELTE TeaM lab in Imagine.

In most cases, programs are used for practicing, showing visual examples, modelling problems, helping to find algorithms for different problems, and conforming constructive learning practices. Of course not all topics can be and should be covered using computer programs, but it can be a motivating alternative for themes that should be practiced and explored from different perspectives. Teachers noticed that children were less embarrassed to make mistakes while using the programs, then while they did similar activities in face-to-face teaching set-up, and that computer graphics and animations can be of great help in better understanding concepts, due to ability of repetition at need.

Case studies of developments

To demonstrate the differences for developing to SEN children we chose two examples. The biggest difference is the need for the precision of configuration in programs. In the first case an existing game was changed into a learning tool, through settings and help functions. In the second case a new learning game was developed for a problem the teachers felt it necessary to help the children to construct their mental model.

Frogs

The Frogs game (originating from the Comenius Logo package and later redeveloped in Imagine; the task of the game is to order the frogs, but a frog can jump only to a free space if there is one next to it, or only one frog away – see *Figure 2.*) is a very useful, helpful and amusing game, which helps children to practice the order of numbers and the concept of numbers, but it could only handle numbers from 1 to 9 without any changes in the sequence of the numbers and numerical order. Teachers however, needed a tool that also allows the practice of sequences from 8 to 12, or sequences like: 13, 17, 21, or also reverse ordering.

After having discussed a framework with the teachers one of our students started to work on its realisation. We decided that the following configurable settings as required:

- Number of the frogs
- Ordering (normal or reverse)
- Starting number
- Steps of the sequence (every number, every second number...)
- Scaffolding (the possibility to see the correct order as a sequence of numbers)

A log file was also required, recording the types of clicks and the time spent on thinking and a visual playback simulation of the log files was also realised in order to trace the process.

The student that got the program development assignment spent lots of sessions at the special education school to see how children (and teachers) manage to make use of it, where modifications might be needed to enhance the user interface, and what parameters might be useful to be inserted in the log file, that records activities. After a long period of iterated developments, a very useful tool was developed with the satisfaction of both teachers and children. The game thus became a very helpful tool to be used in all areas where sequencing numbers is required. It also proved to be a helpful tool for children for self-reflection, in order to construct a more useful algorithm for solving a problem.

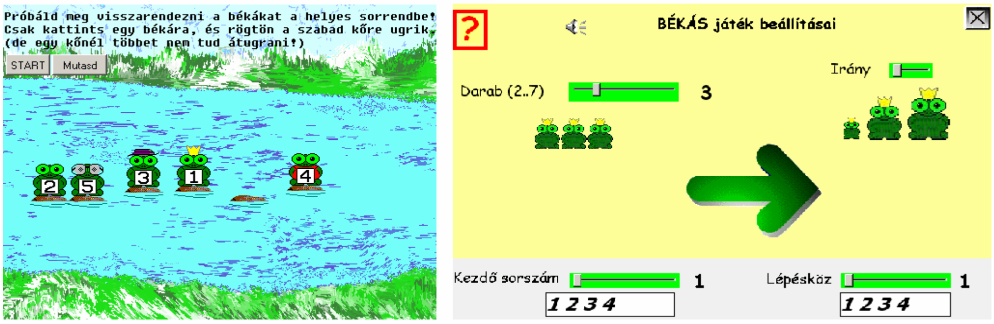

Figure 2. Screens of the Frogs program: original game and configuration page of our version

Grouping

Once teachers have pointed out to the student teachers the need for a program that helps in understanding the concept of grouping numbers, which is actually a preparation for understanding division. They explained the difficulties in the use of small plastic discs (within the official maths package for elementary schools): they always get lost, it is not interesting enough for children, and it is also difficult to check the result of each child's work. So they asked for such a test like program with configurable number of discs and distribution parameters. Small coloured discs would appear in a given number, which can be dragged, grouped as a visual aid for distribution exercises. So one student teacher made a first version to cover the draft of the ideas, this is shown in the picture on the left of *Figure 3*. Later an idea for an interesting metaphor emerged from another student: distributing acorn or hazelnut among chipmunks, and so the other students re-designed it with the new user interface. Then, after some trial period, teachers suggested that chipmunks could give the children tips when they went wrong, and what is already solved correctly. Later the problem of bigger numbers appeared, and finally a division part was also requested, where remainders can be handled step-by-step in the process of division.

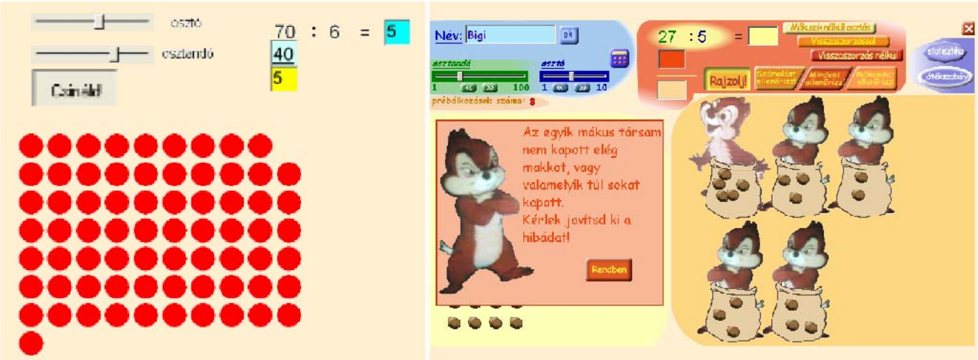

Figure 3. Screens of two iterations of the Grouping program

Evaluation of the programs developed

The design process

Programs developed by student teachers (as developers) in such a situation are of much higher quality then if they would be just a normal course deliverable, since it not only has to comply to the course requirements, but also has to fulfil all needs required by school teachers (as customers making the orders) and most of all that of children (as individual users) who are the most critical factor. Student teachers are much more motivated in producing quality work for children, since children are absolutely honest and immediately give feedback if they like it or not. For the past (more than ten) years, we have been practicing this process of program development, having close ties with several types of schools and kindergartens and have experienced the benefits in terms of quality and overall attention of student teachers towards learners (Turcsányi-Szabó, 2006c). Thus TeaM lab has already come out with hundreds of small educational programs developed within such a process and has produced two considerable learning materials in both English and Hungarian language on how to develop such educational tools. These materials also provide learning paths for constructivist developmental learning for children, and for teachers to learn how to configure the programs themselves, one using Comenius Logo (Turcsányi-Szabó, Abonyi-Toth, 1999; Turcsányi-Szabó, 2004) and the other using Imagine as authoring tool (Turcsányi-Szabó, 2006a; Turcsányi-Szabó, 2006b).

During the long process of cooperation, we both gained knowledge on requirements for development for effective learning tools. It was and is a win-win relationship. Teachers at Bárczi school have deep knowledge on the needs of SEN children and effective pedagogic methods, at TeaM lab we have many years of experiences in developing learning games for children, besides we bring up a new generation of developers, that are sensitive also to the practical needs of children. It is a fortunate bind between the two institutions:

Our student teachers are able to experience the use and effects of developed programs by visiting school classes from time to time, chatting with children on their preferences and consulting with teachers on their needs. It is a new experience for our students to see how small helping tools are needed and how important ergonomical issues and motivating tools for a successful learning process. Student developers can experience the special requirements raised and can later be more aware of the user’s side when considering design issues. It is also important for them to see the motivating effect of a well designed tool, and the learning process in which it is used.

It is also benefit for the SEN children and their teachers to get special designed learning tools, created for the children’s special needs, planed by their teachers and adjusted to their syllabus. In a lot of cases, especially in understanding of concepts and quantity, it was a big surprise for the teachers how much the children learned with the help of a program.

Compared to their earlier methods the in the course of learning developed mental model of the children was much more efficient (Réthey-Prikkel, Turcsányi-szabó, 2007).

Last but not least we in TeaM lab learnt the specialities needed in programs for SEN children, like simplicity in content, simplicity in graphical representation, configurable setting and personalization. We also learnt how important tiny steps are for an efficient learning process, and how many of them are needed for these children.

Special design elements

At the moment Bárczi school uses 36 different programs developed at our university 34 of which were developed at TeaM lab. 28 of these programs are built into the curriculum and are used in classes. From the 36 programs 15 are built to suit the mathematic curriculum and 11 are designed for the ICT curriculum from fifth to eighth grade. Among the programs 18 produces different kinds of log files, 9 saves the final image when a task has been finished and 9 records the whole process.

The main features of all packages for so far developed Bárczi school are:

- **Motivation**: programs are highly motivating and amusing for children.
- **Focus**: all programs focus on a specific theme handled with flexible perspective.
- **Personalization**: programs can be set for the different needs of children concerning level of difficulty, complexity, visual needs, background knowledge and interest.
- **Learning curve and feedback**: activities can be flexibly set in terms of time frame, repetition, feedback, scaffolding, and applicable rewards in order to support the learning curve.
- **Traceability**: activities of children are recorded and can be traced later by checking the log files and saved screen-shots to evaluate the development of the child and the the user interface.
- **Transparent and open**: all programs are developed with the Imagine authoring tool and have similar internal structure that helps further re-developments if needed or media re-configurations by teachers themselves if requested.

The design of log files are of great importance as they are to be used by student teachers during school evaluations in order to monitor progress and pinpoint deficiencies of the program itself.

Most of the log files record the whole sequence of the working process, but it might not be necessary to produce such detailed trails in all cases. E.g. in the program for comparison of quantities, it is enough to record when and which answer was chosen and what the question and the right answers were (see *Figure 4.*). Statistics can also be made immediately and can be stored in files for a quick summery. But in case of the program for using money other events could be more important, since the answer is not a single click, but a sequence of clicks and drag & drops. In this case all clicks that start drags and stop drags are important and are stored in the logs, but as mentioned previously in case of the Frogs program, the visual process can also be reconstructed.

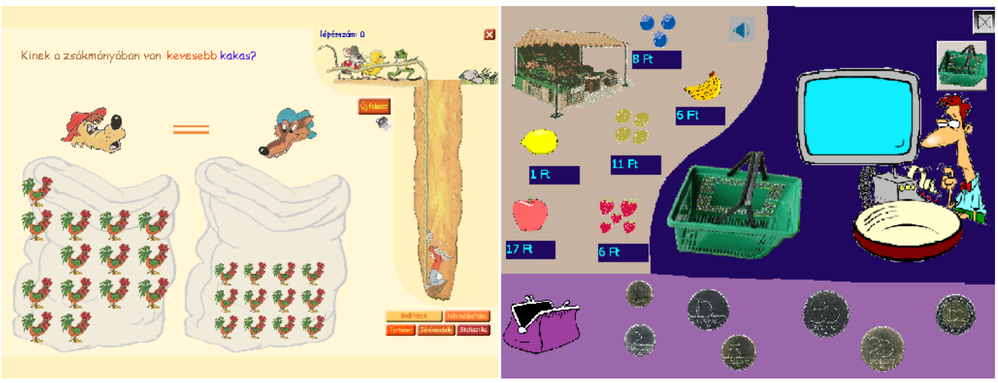

Figure 4. Screen shots of two programs: comparison of two numbers and purchase with money.

We also learned how important it is for children to get immediate feedback on their final answers before pressing the OK button. So we put checkpoints into the programs to allow self-checks before submitting answers. We were interested to learn how often children use these checks and we found out that after working out a solution, they indeed used the self-check every time before submitting a final solution. This feature gave them self-assurance of their thinking process. When such features were not available, children would ask teachers themselves for feedback, which would acquire considerable time from teachers. This is one good reason for the teachers to use such programs in their classes and it also supports self reflection by children and thus provides a more effective learning process.

Scaffolding was also a feature that was required by teachers, e.g. in practicing multiplication, after two wrong answers the multiplication table was shown, and after another wrong answer, the line and column to be used were also highlighted, and next time the needed number was highlighted as well. We had to think of workable algorithms to help the children solve different problems within their abilities, algorithms that provide clear solutions for them as learning skills.

Formal evaluation

The programs developed in earlier semesters were evaluated by student teachers also within course work. During the past ten years we have constructed and refined a rubric for the formal evaluation of educational programs, which has been later adapted by Schoolnet (Sulinet) in Hungary to evaluate the learning objects developed for their repository (SDT). This rubrics contains more than 400 items for check, which seems to be an alarming number, but once a single program is tested in such details, the important features for consideration at the evaluation of any educational tool definitely sticks into the head of the evaluator and next time the main titles of check will automatically retrieve in mind the overall feeling of the features to consider. Thus, student teachers could become good advisors for choosing educational programs in other subject areas as well.

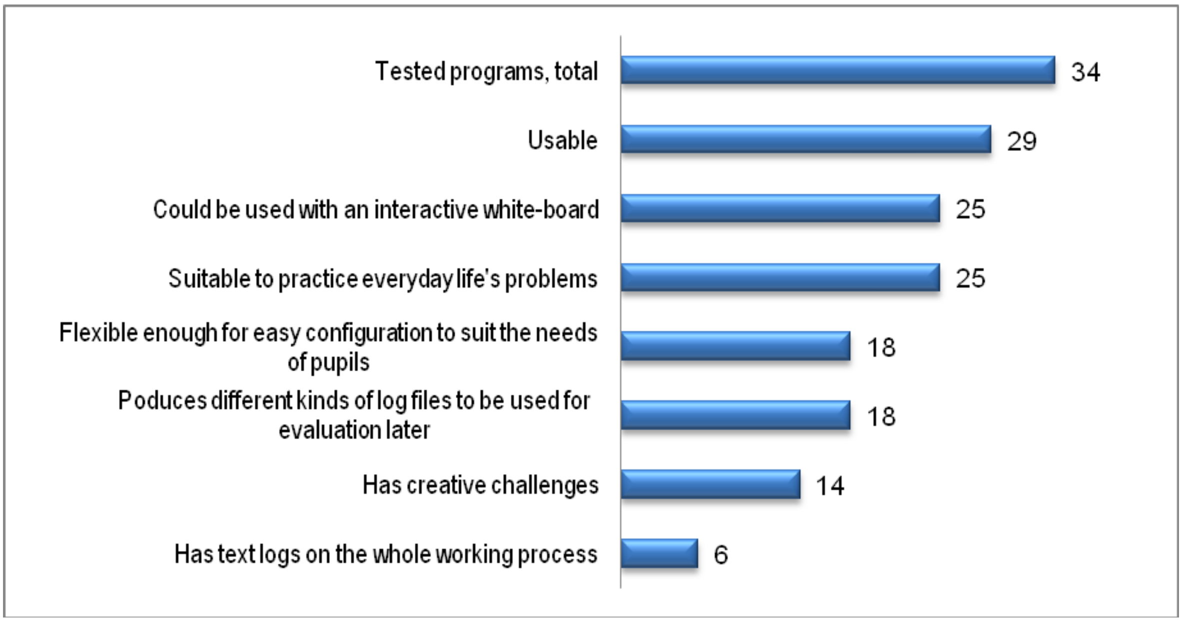

Figure 5. The results on usability tests of all programs used in the Bárczi school designed at ELTE in Imagine.

All 34 programs were also tested for usability against pedagogical criteria (Nokelainen 2006): learner control, learner activity, cooperative/collaborative learning, goal orientation, applicability, added value, motivation and evaluation of previous knowledge, flexibility and feedback. As it can be seen on Figure 5., the teachers rated 29 of the 34 programs as usable, 14 were found to have creative challenges, 25 could be used with an interactive white-board, 25 were found to be suitable to practice everyday life's problems, 18 were rated to be flexible enough for easy configuration to suit the needs of pupils.18 of these produced different kinds of log files (pictures, statistics or step by step logs) that could be used for evaluation later and 6 of them had text logs on the whole working process.

Among the general programs for maths classes (Figure 6.): 15 were built into the mathematics curriculum and teachers are absolutely satisfied with 11 of them; 12 have explicit goals, and 14 allow explicit goals to be given by teachers; 11 are flexible to suit children's needs, 5 have complex settings also for the different special needs of the pupils; and 9 produce log files, 3 create statistics, and 6 have text logs recording the whole working process. Among the programs 6 give direct and immediate feedback to the children, and 6 have motivating feedback animations if the exercise is solved correctly.

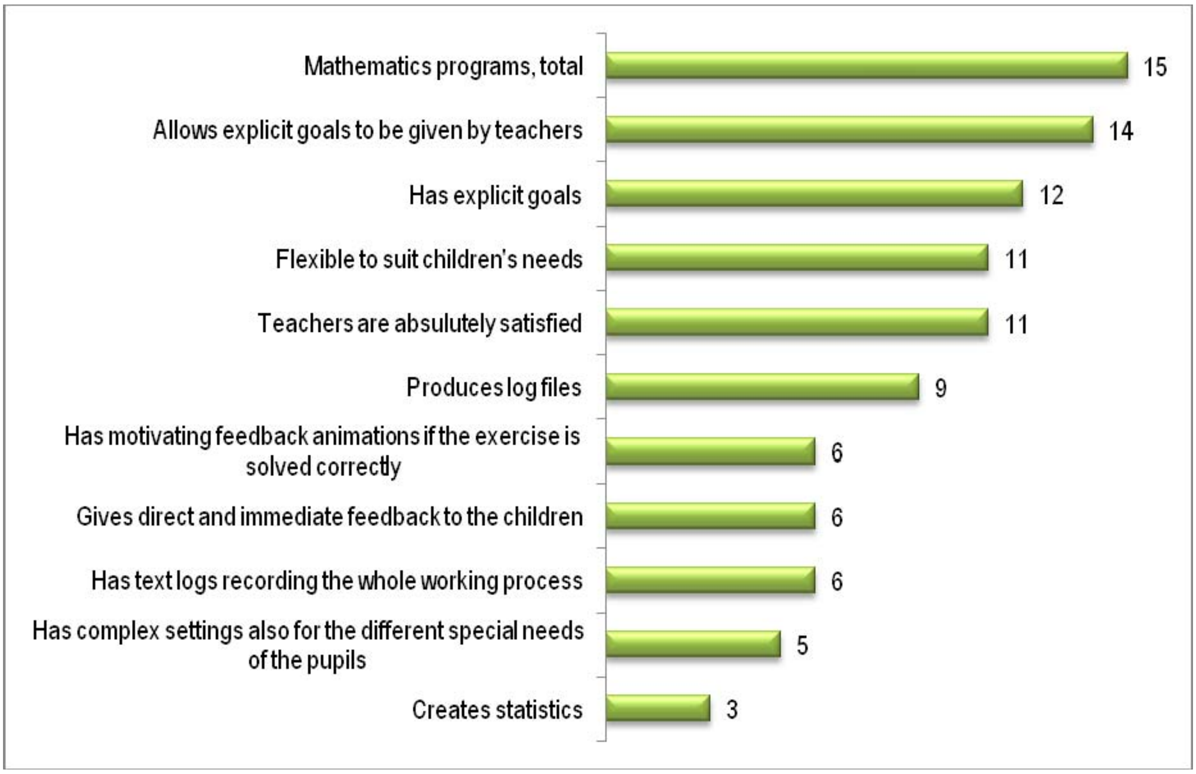

Figure 6. Screen The results on usability tests of the programs used in mathematics classes in the Bárczi school designed at ELTE in Imagine.

Conclusion

Working together is a win-win relationship. Teachers at Bárczi school have deep knowledge on the needs of SEN children and effective pedagogic methods but do not have the time and the knowledge to design the needed tools for their pupils. At ELTE informatics teacher training we have many years of experiences in developing learning games for children, but developing programs for SEN children and visiting classes from time to time gives them a new aspect of using ICT in the process of learning.

It is also a big benefit for the pupils of Bárczi school. Children with learning difficulties need much more time and practice to learn new bits of knowledge. They need much more experience, representations, experiment, explanation, example to extend their knowledge. As we can see personalise-able programs provide adequate help for teachers working with SEN children. It helps to achieve differential teaching. The motivating effect and the direct feedback of computer programs is also of great help, that makes children more self-confident. Unlimited exercises generated with these programs give children the opportunity for the practise they individually require, to develop new mental models and the ability to be able to extend their own knowledge.

References

Dékány, J. (2003) Kézikönyv a diszkalkulia felismeréséhez és terápiájához (Manual book for diagnostic and therapy of dyscalculiások), Logopédiai Kiadó.

Government Decree on the National Curriculum, on web page of the Ministry of Education and Culture: http://www.okm.gov.hu/main.php?folderID=391 and http://www.okm.gov.hu/main.php?folderID=137&articleID=6982&ctag=articlelist&iid=1

Nokelainen, P. (2006). An empirical assessment of pedagogical usability criteria for digital learning material with elementary school pupils. Educational Technology & Society, 9 (2), 178-197.

Nunes, T., Bryant P., (2004). Handbook of Children's Literacy, Springer.

Réthey-Prikkel, B., Turcsányi-Szabó, M. (2007). Design and evaluation of Maths related programs for special education, EuroLogo 2007 Conference, Bratislava

Turcsányi-Szabó, M., Abonyi-Toth, A (1999). NETLogo teacher training material - Microworlds, A CD product of NETLogo MM1020 project (NETLogo – http://www.netlogo.org – not accessible any more).

ed. Turcsányi-Szabó, M., (2004). "HÁLogo portal" (Hungarian NETLogo portal with e-learning material), ELTE University TeaM Lab. Accessible at http://kihivas.inf.elte.hu/halogo

ed. Turcsányi-Szabó, M. (2006a). "Digitális Írásbeliség" (Digital Literacy e-learning material), Sulinet Digitális Tudásbázis (Schoolnet Digital Repository), http://sdt.sulinet.hu/

Turcsányi-Szabó, M. (2006b). Creative Classroom CD Logotron Ltd, Cambridge, http://www.logo.com/cat/view/creative_classroom.html

Turcsanyi-Szabo, M. (2006c). Blending projects serving public education into teacher training. In Kumar, Deepak; Turner, Joe (Eds.) Education for the 21st Century - Impact of ICT and Digital Resources, IFIP 19th World Computer Congress, TC-3 Education, IFIP series Vol. 210, pp. 235-244, Springer. http://www.springerlink.com/content/k8q6107r3gu60838/