

# A Framework for Research on Technology-Enhanced Special Education

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## Abstract

Based on results from the Technologies for Children with Individual Needs Project and two case projects, we propose a new multidisciplinary framework for research between computer science, educational technology, and special education. The framework presents a way to conduct research that aims at developing new methods for technology-enhanced special education and for developing adaptable software and hardware tools for individual needs in educational settings.

## 1. Introduction

An increase in the amount of children with special education needs requires new educational solutions and resources from teachers, and a restructuring of their education. One of these new solutions is the research framework we have created that can be used to guide the design process of long-term, multidisciplinary research projects.

Previous research in the field is strongly focused on assistive technologies and has rarely been entirely multidisciplinary. In particular, severely disabled children's access to active learning with technology has not been studied, except for few isolated studies focused on short-term studies on the use of technological tools. Thus, it is crucial to establish a research project that lasts long enough to get feasible results and to support the optimal development and learning of children whose learning advances slowly. Some research has been done on adaptable technologies in special educational settings, but there still is a lack of research on children with special education needs as active, doers.

The research framework we propose is significant because of its basis on multidisciplinary collaboration and long-term studies in a real environment with varied target groups of special education. The results [1, 2] from the Technologies for Children with Individual Needs Project at the University of Joensuu in Finland have been the basis for generating the framework.

## 2. Research framework

The objectives of the project framework emphasize *multidisciplinary research* that allows the researchers to get new results from natural research settings by utilizing the best knowledge and practices from all of the fields. A general objective is to develop principles for technology-enhanced special education. More specific objectives are developing 1) *a general learning process*, 2) *individual needs* in learning process, and 3) *an awareness of educators* by providing a semiautomatic monitoring in technology-oriented classes (Table 1).

**Table 1. Main objectives and focus areas.**

Objective	Focus	UI	AR	ROB	SREF	MON
General learning process (GLP)	Supporting all phases of a learning process Feedback from learning			x	x	
Individual needs in learning process (IN)	Developing ways to communicate Social activities Emotions Creativity	x	x	x		
Awareness tools for educator (AT)	Teachers' work and education		x		x	x

**Table 2. Proposed technological innovations in the projects based on the framework.**

Application	Existing solutions	Novel technologies	GLP	IN	AT
User interfaces Music Eye tracking Tangible input devices	Music used as a reward Monitoring Touch screen	Music as an aid for making selections Concrete (touchable) interfaces to support learning		x	
Adaptive and adaptable representation	Concept mapping	Concept games (for example intelligent puzzles)		x	x
Robotics	Educational robotics	Tangible programming (input by touch and movement) Self-constructing devices	x	x	
Self-reflecting tool	Self-reflecting environment	Interactive reflection tool Adaptable question sets	x		x
Monitoring	Use of data mining (behavior patterns)	Distributed software agency to support monitoring			x

In Table 1, **UI** refers to user interfaces, **AR** to adaptive and adaptable representation, **ROB** to robotics, **SREF** to self-reflecting tools, and **MON** to monitoring. The abbreviations of the objectives refer to Table 2 that proposes technological advances that we expect to be implemented in the projects following the framework. By applying the latest computer science methods and techniques such as data mining and user modeling research projects can provide innovative results.

### 3. Case projects

Two joint work projects conducted at two universities in Finland have been planned according to the framework described above. *The Adaptable Educational Technologies for Children with Individual Needs Project* has its emphasis on special education, whereas *The Adaptable Software Solutions for Children with Individual Needs Project* concentrates on educational software.

Action research methods are emphasized in the framework and the projects. A cyclic development process in which it is possible to apply various computer science and software engineering methods is a crucial factor. Agile software development methods support the small stages of learning of various groups of special education learners. By observing children for multiple years, it is possible to receive new information and to develop technology according to the children's individual learning styles and needs.

The projects share resources and results, and have a strong emphasis on developing the results of the previous projects. The research will be carried out in collaboration between the universities and local schools. Researchers analyze the material and do field work during the project cycles with rich data collection by video cameras, eye-movement trackers, interviews, observation and a virtual reflecting tool.

The expected results, that is, tools, applications, written materials, and immaterial results can be applied also to general education purposes. In addition, unexpected spin-off results, such as finding a company with an emphasis on the production and marketing of special education tools, are considered important.

### 4. Conclusions

By using the proposed framework, we planned two closely related research projects, which can benefit from each other by sharing knowledge, resources, and results. A deep, long-term collaboration over the borders of the disciplines as well as between various levels of education system is a novel approach, and it has proven to be an efficient way to enhance special education with innovative technological solutions.

### 5. References

- [1] Kärnä-Lin, E., Pihlainen-Bednarik, K., Sutinen, E., and Virnes, M. (2006). "Can robots teach? Preliminary results on educational robotics in special education", *The 6th IEEE International Conference on Advanced Learning Technologies (ICALT 2006)*, Los Alamitos, CA: IEEE Computer Society, pp. 319-321.
- [2] Kärnä-Lin, E., Pihlainen-Bednarik, K., Sutinen, E., and Virnes, M. (2007). "Technology in Finnish Special Education - Toward Inclusion and Harmonized School Days", to appear in *Informatics in Education*, 6 (1).

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