

# **IKASYS: using mobile devices for memorization and training activities**

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**Abstract.** Mobile learning (*m-learning*) integrates the current mobile computing technology with educational aspects to enhance the effectiveness of the traditional learning process. This paper describes IKASYS, an m-learning management tool that provides support for the whole cycle of memorization and training activities in a wide range of domains. The tool has been developed for being used in school-wide environments. This paper focuses mainly on IKASYS Trainer, the application for the mobile device.

## **1 Introduction**

M-learning is increasingly recognized as a strategic tool that has the potential to enable global access to educational materials and improve the quality of education [1]. The small size and portability of mobile devices (PDAs, mobile phones, etc.) make learning location-independent; it is possible to study anywhere and anytime. Although in the context of m-learning most researchers assume that mobile devices are always connected to the Net, this doesn't happen always. Mobile devices can be disconnected, either intentionally or not (connection is too expensive or the adequate infrastructure is not provided [2]).

Regarding hardware, some common characteristics of the current mobile devices are: small screen size, small phone-style keyboard or touch screen, small memory size and limited processing power. Effective m-learning software must be developed trying to overcome technology limits. Even more, it is necessary to follow some guidelines for the design of m-learning software [3]: first design good contents, fit the learning to the learner and then to the device, keep learning efficient, make the learning experience reliable, and accomplish worthy goals. Although the incorporation of mobile devices into learning processes is still at its beginning some attempts are already in development [4][5][6][7].

In educational contexts memorization is conceived as a skill that allows an individual to recall important information verbatim. Although memorization draws upon one of the most fundamental human faculties, it is one of the least exercised techniques in contemporary education, due mainly to the progressive establishment of the constructivist education approach. In order to train this skill several memorization exercises must be carried out. Those exercises involve working with numbers, letters,

syllables, words, signs, drawings, sentences and texts. Solving these activities demands a great effort of attention and concentration.

Along this paper the project called IKASYS is presented. IKASYS is a multilingual system that provides support for the whole cycle of memorization and exertion activities in a wide range of domains. First, it allows instructional designer to author those activities using a web application. Second, IKASYS includes software for students to perform the activities in a mobile device. Third, it provides teachers with a web application for both configuring the student training and inspecting the progress of individual students and groups. The paper starts describing IKASYS System architecture and basis. Then, the paper focuses on the application that runs in the mobile device. Finally, some conclusions and future work are drawn.

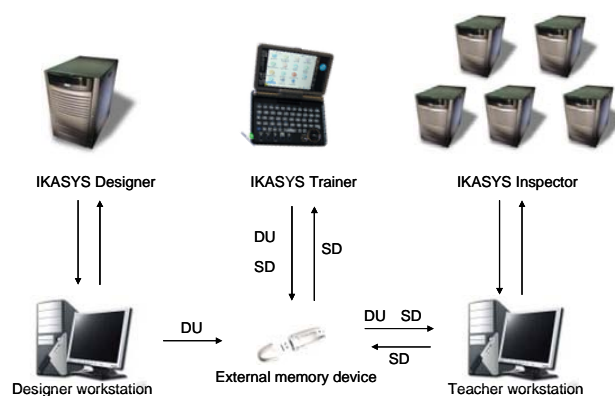
## 2 IKASYS System Architecture and Basis

The architecture of IKASYS framework is shown in Figure 1. It is composed of the next three modules:

**IKASYS Designer** [8] is a web application that provides the instructional designers with an environment for the creation of different types of memorization and exertion activities. As output this application produces the Didactic Units (DUs).

**IKASYS Trainer** is an application that allows students to solve the memorization and exertion activities of a DU in a mobile device. As output it creates a Student Data (SD).

**IKASYS Inspector** is a web application to evaluate the learning process of each student. The IKASYS Inspector must be initialised with the DUs that are going to be used. It takes the SDs as input and visualizes graphically the information about the students' learning progress as well as student groups' progress. It also allows teachers to change certain parameters of the system to personalize the students training. This way, the next time IKASYS Trainer is executed it will take into account the changes carried out.



**Fig. 1.** IKASYS architecture and dataflow

Physically there is one IKASYS Designer server and several IKASYS Inspector servers, one for each school. Data is transferred from one module to another using an external memory device. So, IKASYS based training does not need internet connection. The exchanged information is organized in Didactic Units (DUs) and Student Data (SD). A DU represents a collection of exercises for a domain organized in a pedagogic way. A SD represents the information about the evolution and results of the learner and more general information.

The three components of the systems share the same view of the **learning domain**. It is hierarchically organized in six levels: Knowledge area, Content block, Module, Multilevel package, Level and Exercise. Each learning domain is joined to a specific Area that will be the root of the unit (for example, geography). Each Knowledge area (e.g. Geography) is made up of Content Blocks (e.g. rivers). The content blocks are formed with different Modules (e.g. rivers of Europe). Each module contains Multilevel Packages (e.g. test exercises), those are composed of difficulty based organised Levels in which, finally, are the Exercises without any order.

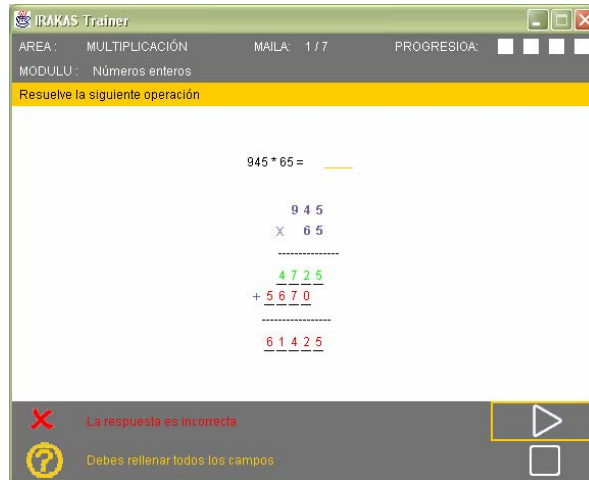
IKASYS offers several **exercise types** to complete DUs. They are classified into two different groups of exercises: static exercises and generative exercises. In static exercises the content designer specifies the whole exercise definition parameters meanwhile in generative exercises only some exercise creation conditions are defined. In other words, the program that runs in the mobile device is able to generate exercises in real time taking into account the conditions that are defined by IKASYS Designer. Among others exercise types IKASYS includes: multiple choices, fill-in-table, word completion, ordering exercises, crosswords, wordsearch puzzle, sudoku, matching columns and classification exercises.

### 3 IKASYS Trainer

IKASYS Trainer is the application for training memorization and exercitation activities in mobile devices. IKASYS Trainer allows teachers to adapt the exercise sequencing depending on the learner characteristics and necessity.

Amongst other capabilities, IKASYS Trainer is able to read, present and manage the content of the DU that the teacher assigns to the learner. The information, such as, the DU, the learner's details and the information about student's performance in the training sessions are stored in an external memory device, personal for each user. So, IKASYS Trainer has to read all the necessary information from the external memory device. In the same way, once the user decides to finish the session, IKASYS Trainer updates the SD with the learners' current level of knowledge, the number of exercises performed and, for each exercise, the result and time that s/he needed to answer. The system also stores some information for the next session, given that the next session will resume the training in the same point.

Upon successful authentication, the program will dispatch exercises to the learner. In Figure 2 the application shows a generative exercise, concretely, a product between two numbers. The values of the variables are calculated in execution time taking into account that those values must satisfy exercise specifications. In this way, the same exercise offers lots of different activities.



**Fig. 2.** Product exercise in IKASYS Trainer

### 3.1 Exercise sequencing

To achieve a personalized learning IKASYS Trainer takes into account the initial difficulty grade that the teacher has assigned to the learner. In addition, exercise sequencing is controlled using several parameters that the teacher can change. Those parameters are: the percentage of exercises the student has to do at least at each level and the percentage of exercise solved correctly per level to allow the student to start the following level. The parameters can be defined and changed by the teacher by means of IKASYS Inspector and are stored in the file which stores student data and exchanged with IKASYS Trainer. Thus, the teacher can define different learning rhythm for each student. During the session exercises are sequenced with an appropriate level of difficulty taking into account the learner progress and the learner will not pass the current level if s/he does not fulfil the demanded requirements.

When learners start a new session, IKASYS Trainer creates four groups of exercises: group of exercises of the current level, group of exercises of the previous level solved correctly, group of exercises of the previous level solved incorrectly and group of exercises that have not done in the previous level

The exercise sequencing algorithm chooses a number of exercises from each group. This percentage is configurable. In addition, in order to avoid repetitive executions of the same exercises the algorithm includes a random factor.

### 3.2 Other pedagogical issues

Regarding other pedagogical issues, feedback relies on correct requirements defined for each type of exercise. Furthermore, it has been probed that visual memory plays an important role in learning. Due to it, IKASYS Trainer will always show the

correct answer, although the learner answer is incorrect. Finally, in order to keep the learners engaged and improve the motivation, the training session should be entertaining. The application attempts to achieve this goal visualizing recreational exercises once in a while, for example Sudokus. This type of exercises is a good way to practice mathematics because it increases children's interest in the subject.

### 3.3 Technical issues

The implementation of IKASYS Trainer was written in Java due to its multi-platform nature. Regarding the operating system, Linux has been chosen because of processor support, reliability, cost, widespread use and its promising future.

Furthermore, this application has been designed taking into account internationalization and localization issues. The current application is localized for Basque, Spanish, Catalan and English.

IKASYS Trainer has been already tested on two different mobile devices; Sharp Zaurus SL-3100 which is shown in figure 3, and in a device designed exclusively for the IKASYS project, shown in the figure 4. Both devices have similar characteristics. They use Linux as operating system. However, Java virtual machines are different: meanwhile Zaurus uses Blackdown 1.3.1 the specialized device uses JVM 1.4.2. Taking into account that Java is multi-platform there is not much difficulty in the migration from one version to another one. Both devices have a screen with 320x240 pixels and a mini-keyboard. In a near future IKASYS Trainer will be tested with more devices in order to finally choose the most appropriate one for real use in a classroom context. The main factors for the final decision are: the cost of the device, the application speed and the ergonomic characteristics of the device, taking into account that it is going to be used mainly with children.



Fig. 3. Mobile device



Fig. 4. Ikasys Trainer

## 4 Conclusions

IKASYS is an m-learning system that is able to author memorization and training activities, to dispatch them in a mobile device, and to evaluate the student progress. IKASYS is composed of three applications that work together but have an

independent logical functionality: IKASYS Designer, IKASYS Trainer and IKASYS Inspector.

IKASYS Designer provides instructional designer with an environment for authoring memorization and training exercises organized in Didactic Units. IKASYS Trainer is the application for students to work with memorization and training activities in mobile devices. IKASYS Trainer adapts the exercise sequencing depending on the parameters set by the teacher. IKASYS Inspector allows teachers to visualize the knowledge state of both individual students and group of students and to establish the appropriate parameters taking into account the learner characteristics and evolution.

Concerning IKASYS Designer a team of specialized instructional designers from the *Gipuzkoako Ikastolen Elkarte* (*GIE*) has already created several real DUs in two domains: Basque language orthography and mathematics. The first one is composed of more than 1,400 exercises and the second one with around 1000 exercises. Regarding IKASYS Trainer it has been already tested on two different mobile devices. Finally, with respect to IKASYS Inspector it has been evaluated by teachers at different educational levels.

IKASYS is SCORM compliant. It provides a follow-up system for supervising the learning process of each individual student or students groups. In addition IKASYS is able to adapt the exercises sequencing to the student behaviour and the capacity to support internalization for which is possible to create content in four different languages sharing the same interface; Basque, Spanish, Catalan and English.

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