Online evaluation in Mathematics courses with iTest: assessment of students learning from pre-school through college

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Abstract

iTest es una herramienta de evaluación online diseñada y desarrollada por el grupo de investigación HEOL (Herramientas de Evaluación On Line) compuesto por profesores de la Escuela en Ingeniería Técnica en Informática de Sistemas del CES Felipe II de la Universidad Complutense de Madrid y por profesores de la Facultad de Informática de la citada universidad. En este artículo, se describen y analizan los resultados de las pruebas más relevantes preparadas y llevadas a cabo por mienbros de este grupo en diversas aulas de matemáticas. Las pruebas no solamente se han realizado con estudiantes universitarios, también han participado alumnos y profesores de distintas escuelas de educación infantil y primaria, así como de institutos de educación secundaria de la localidad de Aranjuez (Madrid). Para poder realizar este proyecto con éxito, se han impartido seminarios de formación de profesores a través del Centro de Formación de Profesores de Aranjuez.

An online evaluation software called iTest has been designed and developed by our research group HEOL. This group is composed of professors from the Computer Science Departments at the Universidad Complutense de Madrid (UCM) campus in Madrid, as well as the UCM campus in Aranjuez. Several activities have been carried out with Mathematics students from pre-school through college using iTest in the past three years in our education community. In this paper we describe the most relevant experiences designed and conducted in Mathematics classrooms. In order to make this project happen, we have collaborated with many instructors from different public schools in our community and we have also given in-service teacher training seminars.

Keywords: *Math education, online evaluation tools, European Space for Higher Education, continuous evaluation, self-assessment and assessment in Mathematics, technology in the classroom, in-service teacher training*

1   Introduction

The traditional classrooms have been around for centuries and still continue to exist in a relatively high amount of institutions despite all the advances in the technology and its implications on education. Nowadays, the Internet offers the possibility of providing a stimulating environment to engage students in deep learning through reflection, application and interaction. Technologies complement traditional education with new possibilities, such as automatically graded quizzes or e-questionnaires, not only as a technology for assessment but also for self-assessment. This aspect is extremely important at higher education nowadays since we all have to work with new methods for teaching and learning focused on the students [1, 4].

There are tools that deal with graded quizzes, such as Hot Potatoes and MegaTest (Zipposoft), and there are complete e-learning platforms used in academia such as Moodle [5] and Sakai [6], that also have modules to generate tests for the students. In these systems mathematical formulas and graphs cannot be easily integrated, accessed, visualized or stored in databases, therefore reuse and portability are limited in general. Moreover, the tests modules in these platforms do not in general provide features such as complete statistics about the results or *controlled random* generation (see Section 2). For these reasons, among other, we decided to create *iTest*, a new more specialized noncommercial online evaluation tool compatible with existing Learning Management Systems such as the ones mentioned above. In a few words, iTest is a web application that allows instructors to configure multiple choice exams and students to take them getting their grades automatically. Through an intuitive interface, iTest allows professors to easily include mathematical formulas and (plane) graphs of functions in the body of questions and answers through a math editor that supports LaTeX type code. It is also possible to insert multimedia files (images, audios, animations and GeoGebra files among others) in the question body. This versatility makes iTest a very suitable tool to design multiple choice tests and to administer them to the students just using an Internet browser.

Fortunately, iTest automatically generates statistics about the results of each examination for the instructor, and this is a great source of feedback that normally is difficult to obtain when paper-and-pencil exams are administered. It also allows students to revise their graded exams being therefore extremely useful as a self-assessment program [4].

Our research group HEOL [3], composed of professors from the Computer Science Departments at the UCM campus in Madrid, as well as the UCM campus in Aranjuez, has designed, developed and implemented iTest. Some members of the group, assisted with interns, are continuously in charge of the maintenance of the tool and they also develop new features as demanded by the users. Other members of the research group prepare and give in-service training courses for teachers in our community and also coordinate all the workshops with students. As we have mentioned before, we are aware of the tremendous difficulties instructors encounter to effectively use new technologies in their classrooms. To help and to encourage them to use iTest, we also offer continuous support to all the users through our web page (http://www.itest.es/) and our email account (itest@cesfelipesegundo.com). As it will be presented in Section 4, our website provides access to a forum, a link to a demo of iTest for student users and also a video where the professor interface is shown.

The paper is organized as follows: first we include a short technical description of iTest. Then we describe all the activities that have been designed and implemented with students of Mathematics at all levels using iTest including some comments about the results. This paper does not pretend to provide a rigorous analysis of the results of the integration of alternative assessment approaches using online learning environments in Mathematics classrooms. We also include

(a) Zoom in a statement with formulas   (b) Graph of a density probability function
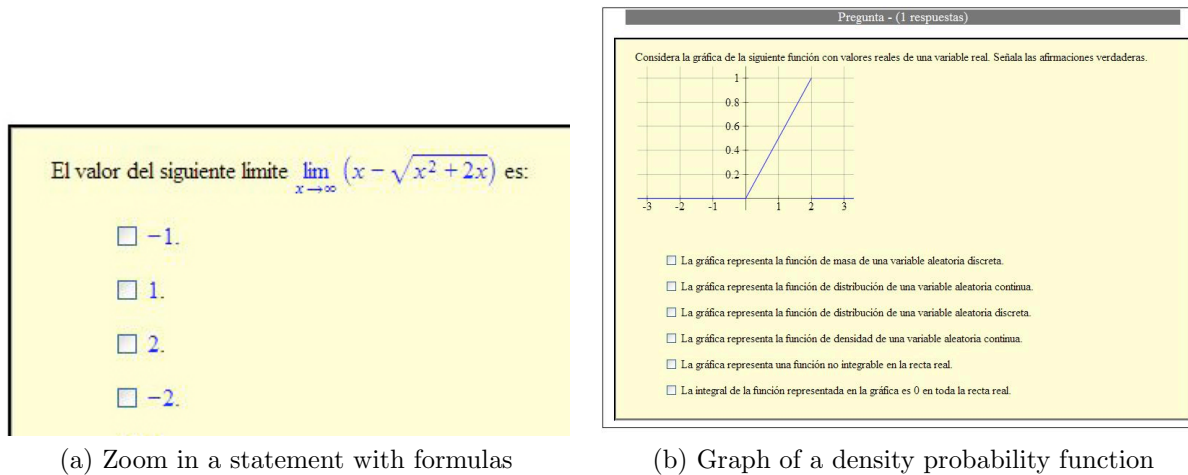
Figure 3.1: Questions including mathematical formulas and graphs using the editor.

a short section where the in-service teacher training seminars facilitated by members of our research group are discussed. We finish this article giving some of our conclusions.

2 Description of iTest

In brief, iTest may be described as an online evaluation tool that allows two different types of users: teachers and students. Teachers may create a syllabus for each course they manage with iTest, they may also add questions to the database (each of them is attached to a topic in the syllabus and to a degree of difficulty) and configure exams. The questions for each student exam are then randomly selected by the tool from the ones in the database according to the configuration parameters predefined by the teacher who in this way can *control the randomness*. If several questions are included in a given topic with a given degree of difficulty, it is easy for any given couple of students to obtain different exams with the same configuration parameters so cheating is very hard. Once the student has completed an exam, her/his score is immediately shown on the screen. Afterwards, the student is also able to revise his/her graded exam if the instructor activates the revision. As mentioned above in the introduction, iTest automatically generates statistics about the results of each examination for the instructor too.

2.1 Mathematical formulas and multimedia support

Any new tool in online evaluation should provide some added value to the current state of the art. In this way, iTest contributes in two different aspects.

On one hand, iTest offers capabilities to create and to edit mathematical formulas, graphs of functions and Venn diagrams (Figure 3.2) in LaTeX-style format in order to include mathematical expressions in questions and answers. This feature is particularly useful because the use of images representing formulas is not mandatory. Figure 3.1 shows an example of a question with formulas and another with a graph typed directly through the editor.

On the other hand, it is also possible for the instructor, through a very intuitive interface, to attach multimedia contents such as *Flash* animation files, image files, GeoGebra (Figure 3.2) or audio files in the question space, and also image or audio files in the answer space.

The application of multimedia features on Mathematics teaching is later explained in Section 3.1.

2.2   Teacher interface

As explained before, iTest distinguishes between teacher and student users. Therefore, each one of those classes of users works on its own interface.

A teacher user may define a syllabus of the course, work with questions, manage exams, register his students, view the grade of any student, and analyze statistics. Regarding more specifically to questions management, iTest allows a complete set of operations for questions. (1) It is possible to add questions and answers, (2) Store data related to a question (subject, difficulty level, visibility, question text, comments for each question to appear in the revision of the graded exams by students, identification name and number of correct answers), (3) Upload multimedia files, (4) Edit a multimedia file (file name and ordering number for visualization), (5) Add or edit answers: each answer is associated to one question, and establish the correct answers for every question (the user may define more than one correct answer), and (6) List the questions with the possibility of filter, edit, modify, activate or delete them. As an example, Figure 3.3 shows the interface for adding and editing a question.

Teacher users may apply public visibility to the questions they include. When this option is selected, the question is available to all the other teachers registered in iTest. This is an important factor that allows instructors to collaborate an then to create bigger and more complete question banks.

In addition, the teacher may obtain for each exam the following statistic information: attendance, passing grades, minimum and maximum grades obtained on a given exam and average time employed to solve a given exam. The tool also provides percentages of correct, incorrect and non-answered questions.

2.3   Student interfaces

A student user can take exams previously configured by the teacher of the course, and also review online the taken exams. Comments about the answer included by the teacher in each question are shown in the revision, which is crucial for self-assessment.
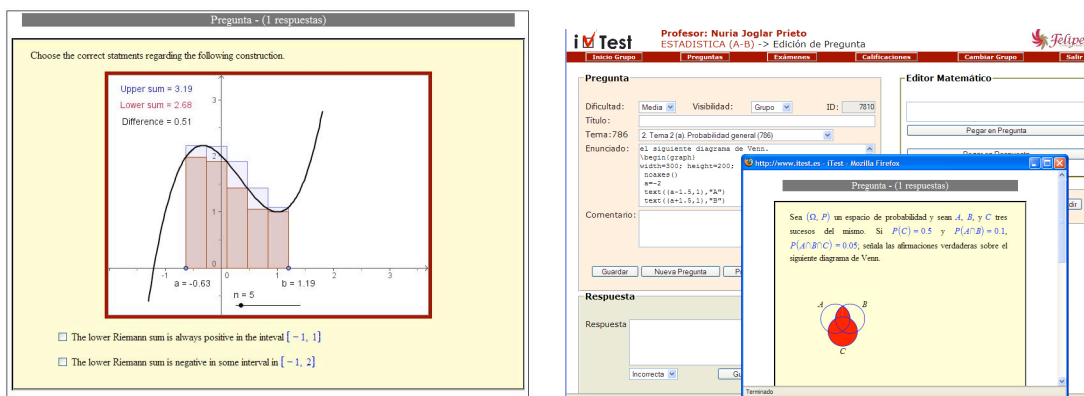

Figure 3.2: Questions including GeoGebra and Venn diagrams.

Figure 3.3: Teacher interface for adding a question.

iTest implements a special interface for pre-school students, called *kid interface*, since the academic year 2007-08. As we will see below in Subsection 3.1, the necessity of a special interface for pre-schoolers was detected after a Mathematics pilot workshop carried out with 4-year-old kids in May 2007. Student users denoted as "kids" receive the exams in a different way as the rest of student users. Kids receive one question at a time and it is individually graded using visual and auditive signals to tell the student if her/his answer to that particular question was correct before passing to the next question. In addition, a special final screen is displayed with a cartoon character showing a happy or sad face depending on the final total score. A kid user only needs to use the click of the mouse to make any test. Screen colors and sizes of the buttons have also been adapted.

2.4 iTest Technology

Through an innovative application and combination of web technologies such as AJAX and MathML (W3C, 2003), server-side Java technology (J2EE under a Spring framework) and database access (Ibatis on MySQL), iTest offers a web tool for online exams where contents and support services are interoperable. In order to obtain a more dynamic application, we also use technologies compatible with the so-called web 2.0.

3 Experiences with students of Mathematics

iTest has been used with Mathematics students from pre-school through college since the academic year 2006-2007. In this section, we enumerate and briefly describe some of the online evaluation activities we have been conducting in Mathematics courses until January 2009. In all of them questions from 3 levels of difficulty were considered. All scores in this section are calculated over a 10 point scale and the frequencies are normalized as percentages.
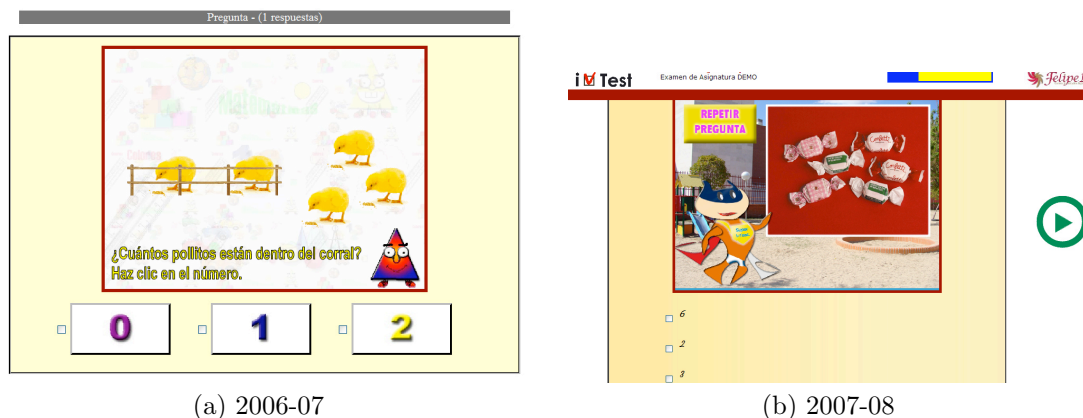
(a) 2006-07   (b) 2007-08

Figure 3.4: Multimedia question for mathematical quiz on kids.

Contents	Student's age	Questions per test	Duration	Scores	Duration
Geometric shapes, colors, counting and series	4	8	30 min.	7.3	9.7

Table 3.1: Preschool Mathematics online test (2006-2007)

3.1 Preschool: online evaluation in early childhood Mathematics

Given the flexibility of iTest, the design of a pilot workshop for small children to test their abilities in early Mathematics was seen as a very interesting challenge by our research group. At the end of the academic year 2006-2007, we organized a pilot experience with a group of 21 students from a local public kindergarten. The contents of these Mathematics questionnaires, addressed to 4-year old children, were designed by a Math professor in our research group with the final supervision of the teachers involved at the kindergarten. The materials were divided in four topics: Basic Geometry, Advanced Geometry, Arithmetic and Logic. Since the 4-year old students were not able to read yet, all the statements for the questionnaires had to be implemented as *Flash animations* where the question was read out loud. Figure 3.4 shows examples of this kind of questions.

One image was included in each answer. Then it was enough for a kid to answer a question to click on the image he/she thought it was the correct one. Students had to use the keyboard to move from one question to the next and to login the application, so colored stickers were stuck on the relevant keys. This activity was administrated in a computer laboratory of our institution. There were several professors, instructors and volunteered college students (including the students working as interns in the group) assisting the children. Children performed extremely well in the test (Table 3.1) and they enjoyed the whole activity. Thanks to this first experience with small children, the need for a specific "kid" student interface was detected (see Subsection 2.3). Many children had problems with the seriation questions (logic-mathematical thinking), when in regular paper activities they have never had. We think that it was difficult for them to imagine the next object in a seriation when in the computer screen the blank final space was not big enough.

Since the experience was positively appreciated by all students, parents and teachers involved, we agreed to help the school teachers to carried out a wider evaluation activity the following academic year. In order to do so, we offered an in-service teacher training seminar during the academic year 2007-2008 (see the details in Section 4 below) and we invested more time in the

Contents	Student's age	Questions per test	Duration	Scores	Duration
Geometric shapes and colors	3	6	20 min.	9.22	7.2
Quantifiers and counting (1-6)	4	7	20 min.	6.63	6.64
Arithmetic: counting and sums	5	7	20 min.	6.81	6.24

Table 3.2: Preschool Mathematics online tests (2007-2008)

design and implementation of a new student interface adapted to the specific needs of small children (see Subsection 2.3). We were able to conduct 3 different tests with mathematical concepts in the third trimester. The group of older students could read numbers and letters using a specific font class. There were some questions with audio files in the body and others with Flash animations. Most of them included images in the answers. Again all the tests took place in computer labs from our college. The 5-year-old students also visited the Radio Set at the Journalism department. Around 15 students randomly selected from each level, took each test. The characteristics and results of each of these tests are summarized in Table 3.2.

Retrieved data show that students were extremely fast answering the questions. As it can be seen in Table 3.2, they used less than one minute per question in general. Their teachers configured durations that tripled the average time length employed by the children. They enjoyed the experience and their results were good. The group of 3-year-old students precised a lot of assistance by the adults present there but their performances were excellent. The group of 5-year-old students got lower results than expected maybe because they were distracted after the visit of the Radio Set. We were also able to analyze the statistics per question with the teachers after the test giving some feedback and also encouraging all of us to continue working with this type of activities (re-adapting the materials when needed). Around 53% of the 5-year old students had problems counting groups of two elements from images (see Figure 3.4) and adding 3 small numbers. Students were not used to this type of questions. The teachers also detected wrong appreciations by some of the smaller children concerning their own performances in the test: they thought that they had done much better than they really did.

As part of a research project partially supported by the City Hall of Aranjuez, we are now preparing a more rigorous study with several groups of 3 year old students. We intend to follow the same students during the whole pre-school cycle (3 years). During the first two years we will try to get them used to iTest. Our goal is to implement iTest as a regular tool in the classroom in the third year so that we can indeed make a rigorous study of the effects of iTest in the children's performances in Mathematics.

3.2   Primary School

During the academic years 2006-2008 we prepared music workshops for 7-8 year old students from the local public music school. Contents of the music workshops were written by a teacher from the music school and the goal of this activity was to evaluate if students from basic courses at the local music school were able to identify musical instruments visually and by sound. Some of the statements for the Music workshop were also prepared as Flash animations to include the auditions in a more attractive format. A total of three computer science major students assisted in the preparation of the Flash animation files in exchange for credit hours as part of a collaborative project.

After this short experience with primary school students, at the beginning of the academic year
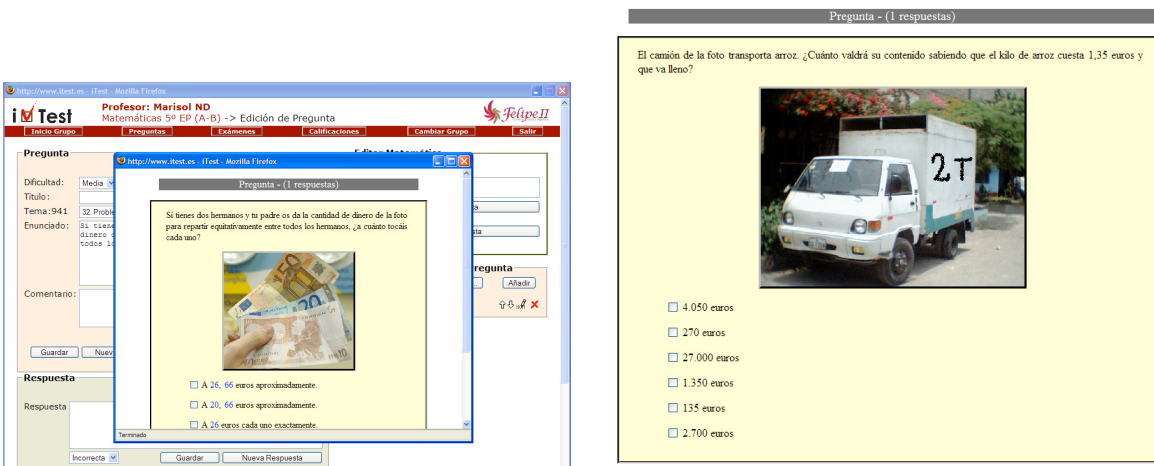
Figure 3.5: Question from K-5 tests.

2008-2009, we decided to design and develop a Mathematics experience with K-5 students (10-11 years old) at a local public school. A total of 40 students are participating in this activity. Through this activity we want to study the integration of alternative assessment approaches using online learning environments in Primary school Mathematics classrooms (see Figure 3.5). We plan to carry out the experiment during 2 complete academic years and we are using design-based-research as our methodology. This is a very flexible methodology that permits revision, reflection and adaptation of the model in temporal cycles.

One of the main goals of this project is to make a comparative analysis of the results obtained by the students in the regular paper-and-pencil exams of Mathematics prepared by their teachers and in online multiple choice tests covering exactly the same topics and adapted to iTest from the paper-and-pencil exams. The online tests are always taken in the school computer laboratory and in the same week than the paper-and-pencil exam is done. We will also observe closely and continuously the students trying to detect possible changes of student's attitudes towards Mathematics when using iTest (e.g. increase in motivation, better concentration on each question, better visualization in Geometry questions, decrease in nervousness while taking exams, . . .). Although this experience is still running and it is soon to make any conclusions, we want to mention here that at the end of the first trimester we compared students average scores in paper-and-pencil tests and in the corresponding iTest using hypotheses t-tests and no significant differences were observed.

3.3 Secondary School

The department of Mathematics of a local public high-school proposed the idea of preparing a math contest for their K7-8 students (12-14 years old). Since they wanted all of their 300 students (divided in 11 groups, 6 in grade K7 and 5 in grade K8) to participate, they thought of using iTest in a first phase of the contest. Some of the professors of the department knew iTest because they had taken one of the in-service teacher training seminars (see Section 4). This first phase took place on February 2008 at their computer labs and the following topics were covered: natural numbers, integers, rational numbers, operations (addition, multiplication, division, powers and square root), divisibility, prime factorization, greatest common divisor, least common multiple, metric system (length, mass, capacity). A total of 302 questions were designed and inserted in iTest by the teachers involved and one exam was configured for each

of the 11 groups participating in the contest. Each exam had 10 questions and the duration established by the professors was 30 minutes. Individual and groups scores were considered. The teachers began motivating students during the first trimester (October-December 2007). The prize of the contest would be a trip to a science museum (Ciudad de las Artes y las Ciencias in Valencia, Spain) for the whole group that won the contest (one group per grade). Since it was very important to help your group, students felt the need to improve their personal performances given that all individual performances would be added to the group final score. Students even asked their teachers for extra homework assignments related to the topics covered in contest so that they could be better prepared.

Once the first phase was completed, the teachers informed the students of their results. The best 5 students of each group participated then in the second and final phase of the contest. This phase took place in one of our auditoriums in April 2008 with a host and an assistant to update the scoreboard. The participants started with the scores they had accumulated in phase one. The host was asking all the groups the same questions, one at a time. Students had a fixed time to get the answer and they could ask for help to their classmates sitting at the stands once. All the questions of this phase covered the same topics as the ones in the first phase and were set in the TV series *Numb3rs* [2]. It was hard to coordinate all the people involved in the contest but it was a great experience for everybody. Teachers noticed that students performances at the end of the year were better in Mathematics due to this experience.

To end this section, we would like to mention a different experience we are developing this academic year with high-school Mathematics students. This activity involves a group of 7 teachers of Mathematics from 3 different regions of Spain and their K12 students. The tests prepared are based on questions from the national exams in Mathematics (for Science and for Social Science majors) mandatory to take and pass in order to access public universities in Spain (*Pruebas de Acceso a la Universidad*). In this case, students will use iTest as a self-assessment tool during the third trimester to help them prepare for the national exams.

3.4   College

There was a strong need in our Mathematics department of a tool like iTest to call students attention towards the study of abstract topics such as Calculus, Discrete Mathematics, Mathematical Logic, Linear Algebra or Statistics. Statistics is a 2nd year course, and the rest are all 1st year college mandatory courses at our institution. This need, becomes even stronger with the arrival of the *European Space for Higher Education* (ESHE) in 2010. In the ESHE the assessment methodology has to change since the learning process is centered now in the students: they have to be continuously evaluated by the instructors and by themselves. iTest provides a perfect complementary tool for the assessment and self-assessment of students in the ESHE environment.

Questionnaires have been administered in some of the courses just mentioned since the academic year 2006-2007. We summarize in Table 3.4 and Figure 3.6 the main characteristics and the results of these first tests. We will give some details about the experiences of the current academic year 2008-2009 at the end of this section. In the "Test configuration" column we include the number of questions in every test of each course, the number of answers shown for each question of the given test and the maximum time length (in minutes) allowed for the corresponding students to take their tests. For most of the questions, only one answer was correct, but there were a few questions with 2, or even 3, correct answers. In those cases, partial grades were assigned automatically. In these first experiences, it was not mandatory for

Academic year	Course Name	Topics	Questions	Questions	Answers shown	Duration
2006-2007	Calculus	5	46	5	4	25 min.
2006-2007	Statistics	3	27	6	4	25 min.
2007-2008	Calculus	15	91	10	5	50 min.
2007-2008	Calculus	15	91	20	5	90 min.
2007-2008	Statistics	18	57	10	5	45 min.
2007-2008	Statistics	18	57	15	5	45 min.
2007-2008	Discrete Mathematics	17	58	3	6	20 min.
2007-2008	Discrete Mathematics	17	58	16	6	90 min.
2007-2008	Linear Algebra	18	28	18	6	90 min.
2007-2008	Mathematical Logic	12	27	13	6	90 min.

Table 3.4: College tests (2006-2008): characteristics

the students to take the tests and some partial extra credit was assigned to the ones who took them.

Most of the tests were taken by the students at our computer laboratories. In some cases during the academic year 2007-2008 (Discrete Mathematics and Linear Algebra), instructors allowed students to take the online tests from their personal computers at home. The instructor activated the tests at night, after 10 pm, and he was available via email to the students through the duration of the test. As it can be seen in Figure 3.6 no significant differences are appreciated in the results when the tests are taken without supervision. The average duration of the Discrete Mathematics test 1 is very low because this particular exam was configured only to have the students checked that all the plugins worked correctly in their PCs and it only represented 1% of the final course grade. When two tests were administered, the percentage of passing students and the average scores were always lower in the second test. This might be because the second tests covered the whole syllabus of the course.

During the academic year 2008-2009, iTest is being used by all the professors at our Mathematics department as a support tool for the continuous evaluation methodology adapting to the ESHE as pilot study groups. In all the Mathematics courses taught in the first semester, 1 or 2 midterm exams were configured with iTest for the students, and the performances on these tests represented between 20% and 40% of the students final grade. Regular paper-and-pencil examinations, as well as group presentations and homework assignments (with or without
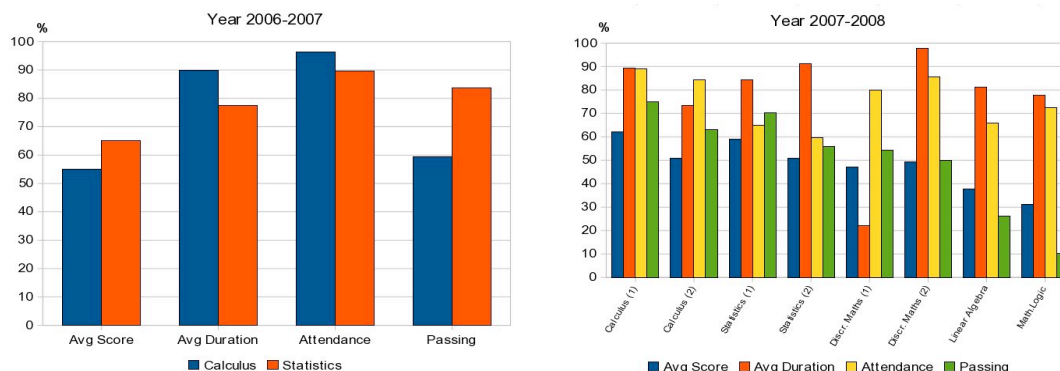

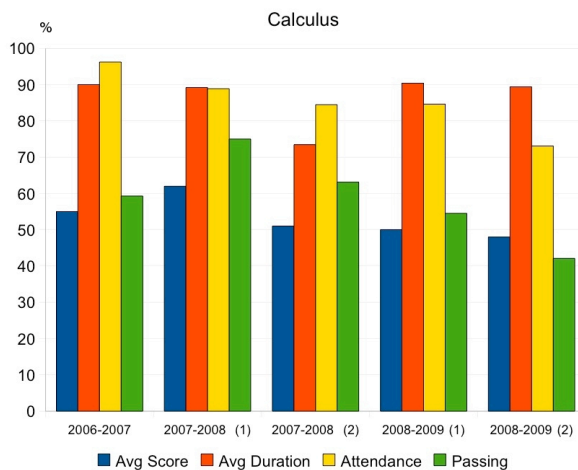Figure 3.6: Percentage results for online college tests (2006-2008)

Figure 3.7: Calculus results with iTest (2006-2009)

iTest) were also considered. It is worth mentioning that in the Calculus course, every student who passed the online exams, passed the course, and only 3 (12% of the students attending the course) students passed the course having failed the exams with iTest. In the percentage chart of Figure 3.7 it can be seen that the average score in the Calculus online tests is slightly decreasing with time. The percentage of students taking the online exams is also decreasing slowly with time. As it was the case with the 2007-2008 results, when two tests where administered, the average score and the percentage of passing students were lower in the second. To finish this section, we would like to express our worries concerning the decreasing of the percentage of passing students in the Calculus online tests with time. In the academic years 2007-08 y 2008-09 the bank of questions used in the online tests was very similar. More questions based on last year of high-school Mathematics books were added to the database and marked as easy questions. It is our impression that students training in Mathematics is falling in high-schools year after year. We also feel that students interest to learn complex concepts involving investing time is disappearing. These aspects have motivated a more intense use of iTest as a self-assessment tool in our courses so that students can detect their learning problems and be still on time to remedy them.

4 In-service teacher training with iTest

Teachers at primary and secondary schools in our country feel often discouraged when it comes to the use of new technologies in the Mathematics classroom. Despite many educational software is available for them through the Spanish Ministry of Science and Education, it is very hard for them to use these applications in a real classroom without close supervision and permanent *live* personalized assistance. We believe that it is really important to study how to build an effective system of preparation and professional development for teachers concentrating on their continuous formation and technical support. In order try to improve this aspect in our education community we established in 2006 a cooperation agreement between our institution, the CES Felipe II (UCM), and the Education Department of Aranjuez City Hall. This agreement includes an annex where in-service training seminars for teachers are considered.

In this section, we give a short description of the in-service teacher training seminars given by professors from our research group.

The iTest in-service training courses for instructors started in the academic year 2006-2007 with a 10-hours course developed mainly for secondary school teachers. Around 20 teachers attended the course. It was divided into five sessions of two hours each. In the first session we gave the participants a tour through the main features of iTest and all participants were invited to do two iTest exams as students. This helped them to realize how iTest works, to explore the way multimedia files can enrich an online exam and to understand how to prepare materials for iTest. In the second session the work was focused on preparing the syllabus for each subject and on adding questions and answers for each topic. Special attention to the inclusion and processing of multimedia files (i.e. images, audio files, animations, . . .) and mathematical equations for both questions and answers on iTest was paid. It is worth mentioning here that the iTest simple and easy-to-use mathematical editor was greatly welcomed not only by the science teachers but also by teachers devoted to classic languages as Greek. Once the teachers managed to have a reasonable number of questions in their subjects, the two subsequent sessions revolved around how to properly prepare an exam on iTest and how to resolve each of the warning issues related to non-properly configured exams. Specific guidelines about how to register students on iTest were also given in this session. In the following weeks all teachers carried out at least one exam using iTest in their classrooms (see Section 3). They were usually assisted by an iTest group member. After these first exams, the last session of the seminar was devoted to look through the exam and question statistics, advising the participants to use them for improving the student weaker areas on each subject. Although it was the first seminar we gave on iTest, all participants were satisfied and really appreciated our closed monitorization at all times. Most of the teachers even confessed that they would not have been able to use iTest with their students without our help. For the development of iTest it was also a great experience: a few bugs were detected and new functionalities were implemented with the valuable suggestions of the participants.

In the academic year 2007-2008 the iTest course for secondary school teachers was given again, having roughly the same attendance and sessions schedule. We were greatly surprised when we noticed that some teachers attending this second seminar had already participated in the first one. Even though they already knew the management of iTest, they enrolled again since for them the close contact with the tool developers acted as a driving force to continue using the tool at their classrooms. In addition to the course for the secondary school teachers, we also started a second iTest seminar for pre-school teachers, based this time on six work sessions of around one hour and a half each. The use of the special kid interface motivated specific sessions in this seminar about how to generate questions and answers using sound-based questions and image answers combined with Flash animations. We also counted with the help of one of our interns, who was working closely with the teachers, guiding them to develop the specific adapted Flash animations and audios. When the materials was ready, several iTest exams were made as it was stated in Section 3. Once again this specific training activity was really welcomed by the participants.

As both seminars had an excellent acceptation, in the current academic course 2008-2009 we are facilitating one seminar, this time for primary school teachers. We have also beginning with a new approach with in-service training based on self-learning (e-learning) teacher groups. As an additional help to all of them, we have developed a web-based service though our web page (http://www.itest.es/). Such website includes the application manual: a 84-page document with several guided practices about how to include questions, answers, multimedia files, configure exams, register students, analyze iTest statistics and so on. The website also contains specific sections for multimedia sample materials, a description of the present and past activities related to iTest in-service training and the active seminars agenda. A forum where

all the users share their experiences and can ask other users their doubts about the tool or its use in their classrooms, a student demo user and a video showing the professor interface are also included in this website.

5   Conclusions

The use of new technologies can be a profitable supplement for the traditional classrooms. iTest supplies automatically graded quizzes, which provides teachers and students a good tool for assessment and self-assessment. This is especially important in the new *European Space for Higher Education* where new evaluation strategies have to be implemented in order to accompany the new teaching and learning methodology. In this direction, our experiences suggest that this type of software is very helpful, but we still believe that extra efforts need to be done by students and professors to adapt better to the new requirements of the ESHE in order to fully benefit from all the advantages of this new system, especially in complex learning domains like Mathematics.

The use of iTest has shown to be helpful to motivate the students too. It is important that students get used to different evaluation systems to awake their critical thinking as well as to the progressive integration of new technologies in the classroom.

The use of mathematical formulas and graphs, multimedia objects and the direct way of obtaining results, grades and statistics of each examination with our tool, have been very useful to Mathematics instructors from all levels of education.

We find extremely important to make connections between the different levels in education to soften the various existing gaps. The collaboration with so many instructors (and students) in the past years has given us valuable information about the performance of our system in real environments, about the satisfaction of their users and its usability. This information will be very practical, not only for the future development of the tool helping us to adapt iTest to the real demands of its potential users, but also for the design of massive testing experiences in the next academic years in our education community.

To finish this section, we would like to mention that for us it is very important to involve the students families with student academic assessment and performance. It is crucial to create bridges connecting schools and families and iTest can help as one since students can revise their graded tests online as many times as they want. It is also possible for the instructor to configure examinations as homework assignments that could even be designed to be completed at home by students with the help of family members through our website. This can definitely help to build a strong connection between families and teachers which could be in turn a very positive aspect in students' academic development.

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