



HAL
open science

LEARNING PROGRAMMING WITH NINTENDO DS

Jean-Pierre Gerval, Yann Le Ru

► **To cite this version:**

Jean-Pierre Gerval, Yann Le Ru. LEARNING PROGRAMMING WITH NINTENDO DS. International Conference on Computers and Advanced Technology in Education, Aug 2010, Maui, United States. <hal-02998774>

HAL Id: hal-02998774

<https://hal.science/hal-02998774v1>

Submitted on 10 Nov 2020

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.



HAL Authorization

LEARNING PROGRAMMING WITH NINTENDO DS

Jean-Pierre Gerval, Yann Le Ru

Institut Supérieur de l'Electronique et du Numérique – Brest
20 rue Cuirassé Bretagne – CS 42807 - 29228 BREST cedex 2 – FRANCE
Tel: +33 (0)2 98 03 84 00, Fax: +33 (0)2 98 03 84 10
E-mail: jean-pierre.gerval@isen.fr; yann.le-ru@isen.fr

ABSTRACT

This paper presents practical activities dedicated to the training in computer programming. The aim of this work is to increase students' motivation into software development. These practical activities were implemented on Nintendo DS. Four activities have been designed concerning: program control statements, functions, data structures and pointers, circular lists and doubly-linked lists. This work was realized in 2007. A survey among the three last year students has been achieved recently and the results are presented.

KEY WORDS

Computer Programming, Practical Activities, Nintendo DS, Software Development

1. INTRODUCTION

In our Graduate School, nearly 300 students are using laptops for various activities. Students have to buy their own laptop and according to this fact they like using sophisticated pedagogical applications. In addition to that our School is mainly a Graduate School in Electronics. Our students are really eager to learn hardware development so that they pay less attention into fields such as computer programming.

First year students are learning computer programming by means of Courses, Lectures and Practical Activities. Courses (12x1.5 hours) introduce main concepts of algorithms: control structures, complex data structures (lists, trees, graphs...) complexity of algorithms, sorting and searching algorithms. Lectures (12x1.5 hours) involve students in designing algorithms especially in pseudocode. Pseudocode is an informal high-level description of an algorithm. It is intended for human reading not for computer reading. During Practical Activities (8x4 hours) students have to implement

algorithms. They have eight activities to achieve with a growing level of difficulty: from basic input/output to binary tree search. Students are working in C language on their laptop.

When they were arriving at School, a lot of students believed that software is especially dedicated to run on computers: Mainframe, PC or laptop. Of course that belief is wrong. Nowadays software is everywhere: satellite dish, cars, TV... even fridges! And it is almost unthinkable to design electronic products that would not include any software component.

In the year 2007 we decided to set up new training activities. Our target was twofold:

- To increase students' motivation into software development.
- To show to students that a software is not especially dedicated to run on a computer.

In 2001 already, an American study [1] showed that on average students (college grads) have spent less than 5.000 hours of their lives reading books against more than 10.000 hours playing video games, not to mention 20.000 hours watching television!

Nowadays, students are surrounded by a lot of new technologies, such as computers, Internet, game consoles, etc. New technologies offer many possibilities of interaction and it becomes more and more difficult to keep students' attention with traditional techniques and methods [2]. Commercial games have created a form of learning that students are very familiar with [3]. Squire proposes a classification of video games: action, adventure, educational, simulation, sports, strategy, entertaining, role-playing games [4]. Game based learning is a nice way to involve students in the process of learning. But our target is not to provide students with educational games [5] nor even serious game [6]; it is to find a way to demonstrate to our students the interest of computer programming.

So the main “game based” aspect of this project stands in the fact that the target machine for students’ software programming activities is a Nintendo DS [7]. It is a handheld game console released in 2004, developed and manufactured by Nintendo. This device features two LCD screens (the bottom one being a touch screen) a built-in microphone and supports WiFi standards.

Using video game console as a tool for education has been experienced by several researchers in various contexts. For example: to support disabled students [8], to improve English lab classes [9], to introduce computer science to tweens (5th - 8th Grade) [10], to teach computer architecture [11]. A comparison of handled devices [12] shows that “NDS has a greater potential for development as an educational ICT than either the iPod or Wii and also NDS affords many opportunities for learners to access, interact with, and manipulate content.”

In the following chapters we will describe both tools available for students’ work and practical activities that were designed. In the last part of this paper we will present a survey that was achieved this year after three years of practice with these training activities.

2. APPLICATION OVERVIEW

2.1 Introduction

We have designed and developed four practical activities. For each activity a statement has been written. It is provided to students. This document contains information that helps students to achieve, step by step, the implementation of the expected result. We also have pre-configured a development toolchain so that students can easily install software tools on their laptop.

2.2 Hardware requirements

Students are using their laptop (Figure 1.) in order to write source code and to cross compile their program.

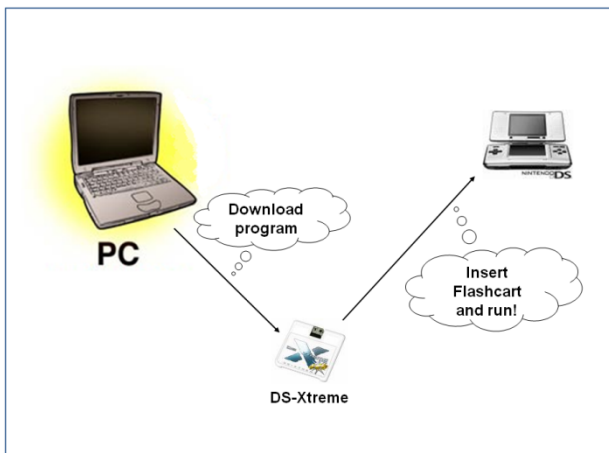


Figure 1. Hardware requirements

Of course we need a Nintendo DS but this is not sufficient. A flashcart (flash cartridge) is requested in order to run the software with the game device. During practical activities, these equipments are provided to students so that they can test their programs in a real environment.

2.3 Development tools

In order to develop software we are using DevKitPro [13]. It is a free toolchain for homebrew game development based on the GNU compiler (MinGW for windows variants) with additional tools and libraries to aid programming supported consoles.

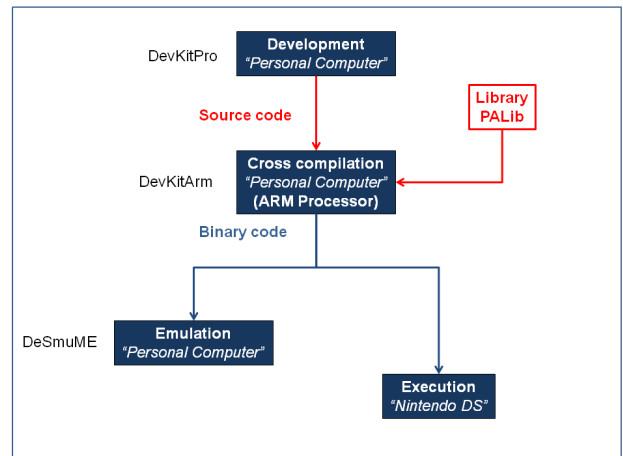


Figure 2. Development toolchain

To produce a binary executable file for the Nintendo DS we need a cross compiler because this console implements an ARM (Advanced RISC¹ Machine) processor. DevKitArm is used for this purpose. To simplify tasks that students will have to work on, we use PALib [14] which is a Nintendo DS library. PALib offers a set of easy to use and high level functions. DevKitPro integrates emulators that enable program testing before downloading binary files to the Nintendo DS. We have advised our students to use DeSmuME [15]. It can play Nintendo DS homebrew and commercial ROMs.

Additional need of cross-compilation and simulation of the device before executing the program should make the process more difficult and cognitively demanding. On the one hand, this might not be a good idea for beginning programmers. On the other hand, it is a good opportunity to introduce this concept. Students will have to practice cross compilation targeting DSP (Digital Signal Processor) or ARM processor during the second semester.

¹ RISC: Reduced Instruction Set Computer

2.4 Practical activities

Activities that were designed are presented hereafter (Figure 3.). Students have to realize these applications in C language. For each practical activity, students are provided with written instructions that are enriched with detailed information. The duration for each activity is four hours.

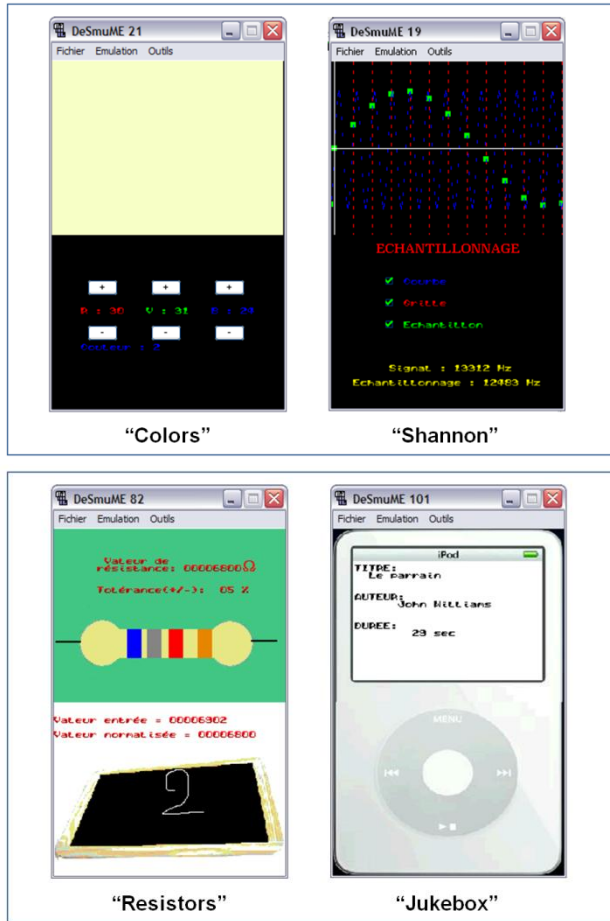


Figure 3. Practical activities

We have chosen practical activities that are targeting concepts which were introduced to students during courses and lectures. We also paid attention to provide friendly applications (Colors, Jukebox) and, if possible, applications that are close to the field of interest of students which is electronics (Resistors, Shannon).

1) Colors

This application deals with **program control statements**. The target is to modify the color of the top screen of the Nintendo DS. On the bottom screen there are buttons that enable to select quantities of Red, Green and Blue.

2) Shannon

This application deals with **functions**. On the top screen students have to draw a sinusoid and a set of sample points. They also have to implement

functions in order to modify sinusoid and sample frequencies. This is a way to demonstrate visually the Shannon theorem.

3) Resistors

This application deals with **data structures and pointers**. On the top screen is drawn a resistor. Students have to manage the changing of colors and to compute the value of the resistor. The bottom screen can be used for writing the value. In that case it is requested to change colors and value on the top screen.

4) Jukebox

This application deals with **circular lists and doubly-linked lists**.

Here, the idea is to implement an iPod like application. On the top screen are written title, author and duration. Commands stand on the bottom screen: play/stop, forward, backward, menu (or playlist).

3. EXPERIMENTATION

Close to 250 students had been trained since 2007. They had eight practical activities to achieve. Half of these activities consist in developing programs in C language with their laptop as a target. The other half is targeting the Nintendo DS.

In order to get a feedback about Nintendo DS activities (the alternative was activities targeting laptop) we have organized a survey from March 16 to 23, 2010, among the three last year students (Table 1.). The participation rate was about 44%.

1	Were development tools difficult to use?	no	35%
		rather no	34%
		rather yes	14%
		yes	4%
2	Did you find these practical activities too long?	no	44%
		rather no	27%
		rather yes	14%
		yes	3%
3	Did you succeed in implementing your programs on Nintendo DS?	no	19%
		rather no	5%
		rather yes	32%
		yes	33%
4	Did you succeed in testing your programs with the emulator?	no	2%
		rather no	3%
		rather yes	25%
		yes	57%
5	Do you think that the statements of these practical activities were sufficiently detailed?	no	3%
		rather no	9%
		rather yes	48%
		yes	26%
6	Would you have liked to have additional explanations about these practical activities?	no	8%
		rather no	15%
		rather yes	45%
		yes	19%

7	Do you think that these practical activities had increased your skills in algorithmic?	no	14%
		rather no	22%
		rather yes	37%
		yes	15%
8	Did you prefer these practical activities compare to the previous ones more "traditional"?	no	7%
		rather no	13%
		rather yes	37%
		yes	32%
9	Do you think that you have learned more during these practical activities than during previous activities?	no	13%
		rather no	27%
		rather yes	36%
		yes	13%
10	Would you like to continue programming on Nintendo DS?	no	12%
		rather no	21%
		rather yes	29%
		yes	26%
11	Do you think that it is interesting to develop program on Nintendo DS?	no	4%
		rather no	16%
		rather yes	34%
		yes	33%
12	Did you find these practical activities funny, amusing?	no	3%
		rather no	7%
		rather yes	33%
		yes	44%
13	Would you have liked to have more details on the hardware (processor, architecture, interfaces...)?	no	3%
		rather no	18%
		rather yes	29%
		yes	37%
14	Do you think that these practical activities were too complex?	no	37%
		rather no	41%
		rather yes	8%
		yes	2%
15	Do you think that it would be interesting to implement such practical activities for training in other computer languages?	no	3%
		rather no	6%
		rather yes	34%
		yes	44%
16	Do you think that these practical activities were interesting compared with others on PC for example?	no	1%
		rather no	3%
		rather yes	53%
		yes	31%
17	The fact that the target was a Nintendo DS had a positive effect on your personal investment during these practical activities?	no	14%
		rather no	16%
		rather yes	24%
		yes	35%
18	Before these practical activities, were you motivated by computer science?	no	5%
		rather no	26%
		rather yes	28%
		yes	27%
19	Did these practical activities increase your motivation into computer science?	no	7%
		rather no	31%
		rather yes	32%
		yes	19%

Table 1. Survey results

Most of students were satisfied with Nintendo DS practical activities. Development tools were not difficult to use (Question 1, no and rather no: 69%); most of them succeeded with the implementation of their application on the Nintendo DS (Question 3, yes and rather yes: 65%) and statements of practical works were detailed enough (Question 5, yes and rather yes: 74%).

The survey shows that students had preferred to work on these practical activities than to work on previous activities more "traditional" (Question 8, yes and rather yes: 69%). It was funny, amusing and interesting to develop program on Nintendo DS (Question 12, yes and rather yes: 77%). Also, targeting the Nintendo DS had a positive effect on the personal investment of student during practical activities (Question 17, yes and rather yes: 59%).

Finally, compare to the alternative students were enthusiastic (Question 18, yes and rather yes: 84%) and a majority of students say that these practical activities increase their motivation into computer science (Question 19, yes and rather yes: 51%).

4. CONCLUSIONS AND FUTURE WORK

At the end of the survey we were asking students for suggestions. Students' new proposals were numerous. We are paying particularly attention to some of these proposals, for example:

- To develop a real game.
- To use sprite (graphic image that can move within a larger graphic) and to manage animations.
- To increase the development of graphical interfaces.
- To develop a network oriented application using WiFi between two (or more) Nintendo DS.
- To extend such game oriented applications to other topics than Computer Science.

According to the results of our survey most of students were satisfied and we will continue to involve students in such activities.

REFERENCES

- [1] Prensky M., *Digital Natives, Digital Immigrants*, MCB University Press, vol. 9 (5), 2001 p. 1-6.
- [2] A. Ferreira, A. Battaiola, R. Tori, N. Elias, *Game Technology as an Educational Tool*, Informatics Curricula, Teaching Methods and Best Practice (ICTEM2002), July 10-12, 2002, Florianópolis, SC, Brazil
- [3] J. Foreman, *Game Based Learning*, EDUCAUSE review, September/October 2004
- [4] K. Squire, *Video games in Education*, The Education Arcade, www.educationarcade.org/gtt/pubs/IJIS.doc (Retrieved on June 2010)

[5] M. Garay Serrano, M. Gaspar Rodríguez, J.E. Agudo Garzón, and H. Sánchez Santamaría, Learning experiences by using video game consoles, V International Conference on Multimedia and ICT in Education, 22-24 April 2009, Lisbon, Portugal

[6] Iza Marfisi-Schottman, Aymen Sghaier, Sébastien George, Patrick Prévôt, Franck Tarpin-Bernard, Vers une industrialisation de la conception et de la production de Serious Games, Conférence EIAH'2009 (Environnements Informatiques pour l'Apprentissage Humain), 23, 24, 25 et 26 juin 2009, Le Mans, France

[7] <http://www.nintendo.com/ds> (Retrieved on June 2010)

[8] E. Pearson and C. Bailey, *Evaluating the potential of the Nintendo Wii to support disabled students in education*, In ICT: Providing choices for learners and learning. Proceedings ascilite Singapore 2007

[9] M. Shirali-Shahreza, *Improving English Lab Classes Using Sony PSP (PlayStation Portable)*. Proceedings of the 8th IEEE International Conference on Advanced Learning Technologies (ICALT 2008), Santander, Spain, 2008, pp. 489-490

[10] Gary Kacmarcik, Sylvie Giral Kacmarcik. *Introducing computer programming via gameboy advance homebrew*, Proceedings of the 40th SIGCSE Technical Symposium on Computer Science Education, SIGCSE 2009, Chattanooga, TN, USA, March 4-7, 2009, pp 281-285

[11] Maria J. Santofimial, Francisco Moya, *Nintendo DS: A Pedagogical Approach to Teach Computer Architecture*, International Conference on Embedded Systems and Applications (ESA'09) July 13-16 2009, Las Vegas, Nevada, (USA)

[12] Michael Morgan, Matthew Butler, Mark Power, *Evaluating ICT in education: A comparison of the affordances of the iPod, DS and Wii*, Proceedings ascilite Singapore 2007.

[13] <http://www.devkitpro.org/> (Retrieved on June 2010)

[14] <http://www.palib.info/wiki/doku.php> (Retrieved on June 2010)

[15] <http://www.desmume.com/> (Retrieved on June 2010)