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ICT Integration into Chemistry-Physics Classes In Middle Schools Through A Participatory Pilot Project Approach

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Abstract

Information and Communication Technology (ICT) based education was examined, through an integrated project, to experimentally determine how such technology could influence the motivation and performance of students in science (Chemistry-Physics, Mathematics, and Life-Earth sciences) in Morocco. The experiment was deliberately run at middle school level (age 12-14) as it constitutes the best stage in student life to influence their choice for the field of study. Two schools were selected based on their location and environment; one in a semi-rural area of Ifrane, and the other in the large city of Fes. The present study focuses more on the physical sciences (Chemistry-Physics), as they are taught together by the same teacher and represent a structural template of what was carried out within the framework of the pilot project.

The project was the first of its kind in Morocco since it permitted decent usage of ICT in classroom sittings and allowed integral participation of middle school teachers in the elaboration of ICT pedagogical teaching resources using Arabic as teaching language. Control (standard) and experimental (ICT-based) classes were both taught by the same teachers and all the experiments were carried out in close collaboration between the authors and the teachers, with assistance from ICT engineers and technicians.

Quantitative evaluation of the experimental data based on general balanced 3-stage nested design, together with qualitative assessment show a positive impact on the performance and motivation of students as well as their teachers.

The project established successful practice guidelines and has set a promising roadmap for extending it at a larger scale to the rest of the country.

As expected, this project encountered obstacles and limitations. Lessons learnt as well as suggestions are presented in this paper

Keywords: Morocco; ICT education; Chemistry; CITI project; Participatory approach

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1. INTRODUCTION AND BACKGROUND

The application of ICT-based education in science has been the focus of several studies [1-13]. This interest stems from efforts to improve education in terms of effectiveness and efficiency through the use of ICT.

In general the education of science and technology in Morocco is confronting challenges at times the country needs more quality engineers to satisfy its exponential industrial development[10]. In fact, the level in science courses of the majorities of Moroccan students in middle and high schools has been described as below expectations and consequently a decent percentage of Moroccan pupils do not reach higher education [11]. In order to address these issues, the CITI [14] had conducted a three year project sponsored by the Korean International Cooperation Agency (KOICA) [15], with the goal of developing competency and useful IT-based instructional materials for Moroccan Junior High level mathematics and science instruction as a foundation for the larger project that would improve and assist primary and secondary education in Morocco. More details about the background, the constraints, the structure of the project, its human and physical resources, the development of the e-learning environment and digital resources can be consulted in [12]. In this paper, the focus is on the approach used and the analysis of the results achieved in improving motivation and performance of pupils as well as teachers in Chemistry-Physics education. We also shed some light on the obstacles encountered and the lessons learned from this project. The originality of this study is not so much in the introduction of ICT in education, which has been tried and/or is in use in many countries, but in its research-based operation methodology and its participatory approach. Thus, making teachers directly involved in content development and facilitating their acceptance of the technology. However a resistance or rejection to change in pedagogy with little or no participation by the teaching body can be observed if this ICT approach is imposed from above. In addition, the introduction of technology in educational institutions without providing any structure for maintaining the equipment or training users (pupils and teachers) in how to make effective use of the equipment for educational content development, presentations, studying and learning may result in failure.

2. METHODOLOGY

2.1. Experiment Strategy

The project involves three implementation stages: development of the pedagogical tool, testing, and evaluation. The two pilot institutions in this experiment are Al Arz Middle School in Ifrane (a small town in the Middle Atlas mountains of Morocco) and Kassim Amine Middle School in Fez (an imperial city located at 60 km north of ifrane). Most of the students in these schools are from low income families, and are therefore less exposed to computer technology. Three Chemistry-Physics teachers together with one pedagogical inspector from the same discipline, in each of the two pilot middle schools, contributed to this project. Each teacher was responsible for the experiment in one middle school grade. Before the start of the experiment, the teachers and the inspectors (who jointly constitute the pedagogical teams) were requested to design scenarios of lessons integrating ITC in the Moroccan curriculum. The technical team, composed of ten engineers and technicians at CITI, was responsible for digitizing modules proposed by the pedagogical team, managing the project platform and installing and maintaining the computer equipment in the multimedia rooms, as well as recording typical distinctive class lectures and presentations. Joomla was chosen as the platform for managing the digital content (Content Management System, CMS). The choice of Joomla was based on its easiness to configure and to personalize, in addition, Joomla is one of the rare platform that provide support for Arabic language (Joomla won the best Open Content Source Management System award in 2006). This platform includes functionalities necessary for teaching with digital resources, permitting therefore the addition of modules such as

quizzes, interactive tests, text and video courses, whiteboards, agendas, forums, blogs, surveys, RSS news feed, games, chat, television and radio streaming, etc.. Users of this platform can as well create their own templates by arranging the menus offered to suit their own interests.
Digital courses were organized by class level and by subject matter. With each course containing several elements, such as: lecture notes in PowerPoint format, introduction and summary of lectures, videos, quizzes, interactive exams, simulations, educational games and virtual laboratories.
Registered users were given access to personal agenda allowing them to organize their work. They were as well able to share files, post events, create blogs, and contribute to a whiteboard in order to exchange ideas online. Forums allowed for virtual meetings, exchange and offered significant teacher-teacher, teacher-student, and student-student interactivities [14].
Furthermore, teachers who use the platforms can upload lectures and participate in the development and diversification of the content. Readers of all uploaded educational material have the possibility of introducing their comments.

2.2. Preparation for the Experiment

The entire pedagogical team benefited from appropriate training sessions and workshops. Teachers and inspectors from the participating middle schools took part in training course organized by CITI. The training, spanning 24 hours over the space of 6 weeks, targeted the basic tools: Word, Excel, PowerPoint, Internet exploration, e-mail, and use of the digital platform of the project. The center also organized approximately ten pedagogical workshops on ICT integration in teaching for all participants to the project. These workshops allowed different actors to share and discuss their experiences thus allowing an effective and improved execution of subjects contents.

2.3. Resources' Development

For each discipline and in each pilot middle school, the three teachers in charge of the experimental class were responsible for designing the scientific and pedagogical content, integrating ICT according to a plan drawn up by CITI and advised/approved by an academic inspector. This design was based on the official Moroccan education program. The chosen model is constructivism and the development methods for different pedagogical scenarios were based on the experimental process and/or the problem situation. Worth mentioning that in physics and chemistry, we recommend that the teacher opts, whenever possible, practical (manual) experiments/exercises to computer simulation.

2.4. Digitization of Scientific and Pedagogical Content

The technical team from CITI was responsible for the digitization of different content (implementation of flash animations, interactive exercises, film sequences, virtual experiences, photos, power point presentations,...) proposed by the pedagogical team and its insertion into the platform. The team's technical work was closely followed by CITI coordinator, as well as the proper pedagogical team. The digital products created by them were also evaluated from a scientific and pedagogical perspective.

2.5. Internal and External Validation of Multimedia Outputs

Once the digital pedagogical resources were produced by the "content experts" and the CITI computer technicians, regular discipline-specific meetings were scheduled in order to internally validate the coherence of the products and their adherence to pedagogical objectives set out by the actual national programs.

Within the framework of the collaboration between Al Akhawayn University in Ifrane (AUI) and the Ministry of National Education, and with the aim of better judging the technical quality and pedagogical orientation of the elaborated resources, an external audit was set through by a team from the Ministry of National Education representing the National Centre for Pedagogical Innovation and Experimentation

(CNIPE). This team as well as ICT Education experts reviewed the content of this educational digital products

After having formulated various comments on the different aspects of the products, notably at the pedagogical, ergonomic and multimedia levels, the main team submitted an evaluation report followed by recommendations for improvement.

2.6. Experimental Model

To investigate the impact of ICT-based education on the scholastic performance in the two middle school students in Chemistry-Physics, we designed a three stage nested experiment. More detailed explanations about this design can be found in our previous work [12].

For each middle school level, two groups (A and B) of twenty students each (one student for each computer in the multimedia room) were randomly chosen (with the usual distribution except that, in ordinary classes, the class size is forty). In parallel, the chemistry-physics teacher was also randomly assigned to teach one level in each middle school.
Group A (the experimental class) followed the course of study with the aid of ICT in the multimedia class. Group B (the control class) followed the same course of study with the same teacher but in an ordinary classroom and without the aid of ICT (See Figure 1). The two groups underwent identical evaluations each trimester. A statistical analysis of the results of the two classes, A and B, would permit a quantitative evaluation of the impact of integration of ICT.
For all three middle school levels, the performance of the experimental and control groups in each discipline in both schools was assessed using the same examinations.

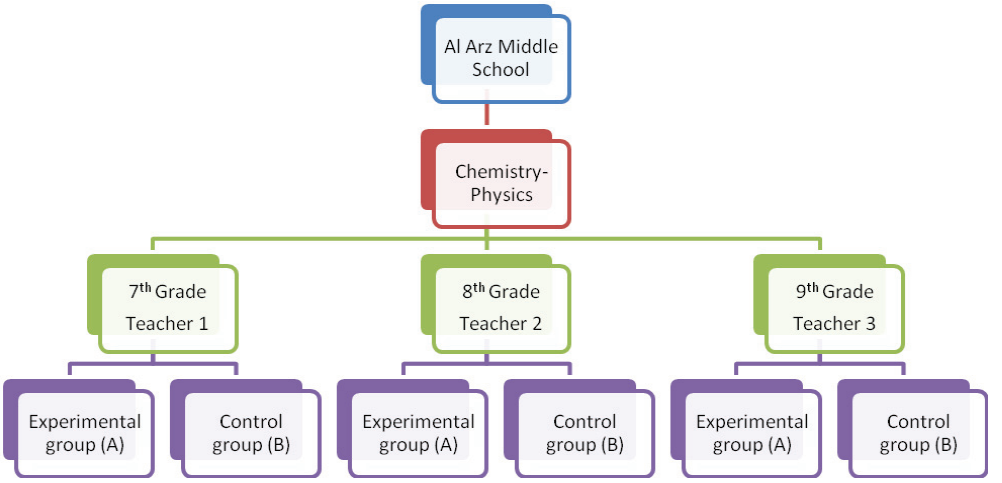

Figure 1: Experimentation flowchart for one middle school. Both experimental and control groups are taught by the same teacher. Both classes of the same level were assessed using the same examinations.

3. RESULTS AND DISCUSSIONS

By comparing the class averages for both the experimental and the control groups, in each grade of each middle school (Figure 2), we noticed the outperformance of the experimental group as compared to the control group.

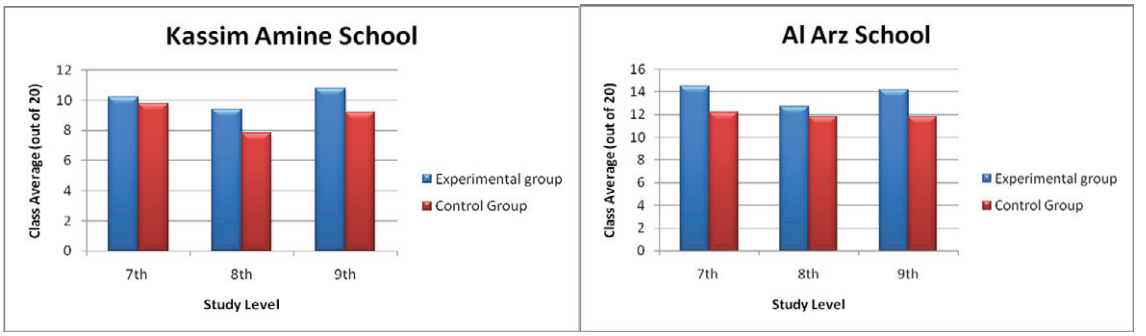

Figure 2: Class averages of the experimental and control groups in both schools.

For more accurate statistical evaluation, we conducted a T-test as described in our previous work [12]. The null hypothesis of the T-test states that the means for both groups are the same and the alternate hypothesis states that the mean of the experimental group is higher than the mean of the control group. Our T-test was conducted at an 85% confidence level and our decision was based on the p-value of the test as follows: tests with p-values less than 15% reject the null hypothesis, meaning the experimental group outperforms the control group. Results of this first analysis are summarized in Table 1.

	Kassim Amine Middle School			Al Arz Middle School		
Level	**7th**	**8th**	**9th**	**7th**	**8th**	**9th**
P-value	0.632	0.102	0.098	0.014	0.182	0.027
Test results	No	Reject	Reject	Reject	No	Reject

Table 1: Results of 85% confidence level one sided T-test comparing experimental and control groups' performance for the three considered grade levels

Our analysis indicates positive impact of using ICT on student's learning and performance in Chemistry-Physics for the 8th and 9th grades in Kassim Amine middle school and 7th and 9th grades in Ifrane middle school. Overall, this represents a successful rate of about 67% in both schools. In parallel to the quantitative analysis, we conducted a surveys and classroom observations in order to measure qualitative impact of using ICT in classes. One of the noticeable results is the high motivation for the use of ICT tools in the teaching and learning of chemistry and physics.

5. CONCLUSION

This study shows positive impact of ICT-based education in chemistry-physics education in middle schools. We noticed that our T-test analysis, even though with a 67% success rate, was not consistent across all levels in the two pilot middle schools except for the 9th grade. Knowing that proper pedagogical usage of ICT tools is a deterministic factor in classroom performance, we believe that the

observed discrepancies are probably due to this factor. We believe, therefore, that teachers need to be accompanied towards efficient integration of ICT in their daily teaching practices.

Some aspects and learned lessons from the conduction of this project could be summarized as follows:

- A rigorous planning of the project (definition of objectives, means, resources and actions) allowed the project to advance, not as a predefined product, but rather as a continuous act of regular questioning of adaptation to context and constraints.
- The coherency of needs and the delivered training programs for teachers are vital for the successful implementation of any ICT based project in science education.
- The creation of a climate of confidence that limited to some extent the degree of resistance to changes.
- Psychological motivation and material incentives for different actors in the project are of crucial importance to carry out similar studies.

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REFERENCES

[1] Haddad, W. D., Jurich, S. (2002). ICT for Education: Potential and Potency", in Haddad,W. & Drexler, A. (eds),Technologies for Education: Potentials, Parameters, and Prospects (Washington DC:Academy for Educational Development and Paris: UNESCO), pp. 34-37

[2] Park, H-R., Khan, S., Petrina, S. (2009). ICT in Science Education: A quasi-experimental study of achievement, attitudes toward science, and career aspirations of Korean middle school students, International Journal of Science Education 31(8), pp 993 – 1012

[3] Robinson, B. (2008). Using Distance Education and ICT to Improve Access, Equity and Quality in Rural teachers' professional development in western China. International Review of Research in Open and Distance Learning 9 (1), ISSN: 1492-3831

[4] McCollum, K. A. (1997). A Professor Divides his Class in Two to Test Value of Online Instruction. Chronicle of Higher Education 43, pp. 23, 1997.

[5] Babin, R., Grant, A .k., Sawal, L. (2008). Identifying Influencers in High School Student ICT Career Choice). Information Systems Education Journal 8(26) ISSN: 1545-679X

[6] Green, G. and Sanders, J. W. (2002). Using Computer-Aided-Technology & Self-Paced Learning to Increase Spanish I Scores in Middle Tennessee High School. Tennessee Educational Leadership, 31 (2), pp. 32-36

[7] Hannay, M., Newvine,T. (2006). Perceptions of Distance Learning: A Comparison of Online and Traditional Learning". MERLOT Journal of Online Learning and Teaching

[8] Daughenbaugh, R., Daughenbaugh, L. (2002). Surry, D. and Islam, M. Personality type and Online versus in-Class Course Satisfaction. Educause Quarterly, (3)

[9] Legrouri, A., Ouardaoui, A., Darhmaoui H., Loudiyi, K., Berrado, A. (2010). Introduction of ICT into Middle School Chemistry-Physics Education in Morocco, International Conference, on 1O th European Conference on Research in Chemistry Education, ECRICE, July 4-9 2010 Krakow , Poland

[10] Smith, K , Darhmaoui, H., Loudiyi, K., Berrada, F., Berrado,A. , Cavalli-Sforza V., El Asli, A., Legrouri A., Messaoudi, F., Ouardaoui, A., Sendide, K. (2009). CITI: Experience in introducing ICT into Middle School education in Morocco, Proceeding of the ICL2009, September 23 -25, 2009 Villach, Austria.

[11] Smith, K, Darhmaoui,H., Alaoui, C., Bensaid, A., Berrada, F., Berrado,A., Driouech,O. ,El Asli, A., Legrouri, A., Loudiyi, K. Messaoudi, F., Mouline, F., Ouardaoui, A.,. Sendide,K. (2008). Bringing Information Technology to Middle School Instruction in Morocco, Proceedings of the 2008 International Conference on Technology in Education,3-5 March 2008. Valencia, Spain.

[12] Berrado,A., Darhmaoui,H., El Asli, A., Legrouri,A., Loudiyi,K. Messaoudi, F., Ouardaoui, A., Sendide, K., Smith. ,K. (2009). Measuring The Impact Of Introducing ICT Into the Instruction Of Mathematics, Physics, And Earth and Life Sciences In The Three Middle School Levels In Morocco ICERI 2009, 16-18, November 2009, Madrid.

[13] Salman, R, Farooq S. M., Hafeez. S. (2011). International Journal of Academic Research in Business and Social Science 1, Special Issue ISSN: 2222-6990

[14] Center for IT Innovation, http://citi.aui.ma, May 2009.

[15] Korea International Cooperation Agency, "Making a Better World Together", http://www.koica.go.kr/, May 2009.

[16] Joomla, Because Open Source Matters," http://www.joomla.org, 2008.