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Perceptions of the first-year university students of the use of ICT in the teaching of physics: case of a course of electricity

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ABSTRACT

Within the framework of a research aiming to evaluate the impact of the use of Information and Communication Technologies (ICT) in higher teaching of physics, we carried out a study with 122 students enrolled in first year of the science spinneret of the physical matter (SMP) at the University Sidi Mohammed Ben Abdellah, Faculty of Sciences Dhar El Mahraz – fez. This study aims in particular to identify the perceptions which these students have after learning the course of electricity integrating the ICT. The results of our investigation also show that the use of these tools in this course has provided an easy and convenient access to its scientific content and improved the learning of 48.4% of the questioned students, in addition it allowed 52.5% of the surveyed students to actively participate and to ask more questions during the course. The results of our study have also shown that the teaching of the course of electricity within the university should be accompanied by a handout and based on more developed and detailed demonstrations in the board and a judicious use of the presentations integrating filmed experiments.

Indexing terms/Keywords

ICT, higher teaching, physics, electricity

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INTRODUCTION

The integration of Information and Communication Technologies in education (ICTE) within the establishments of the scientific spinneret licenses higher teaching is subject to important debate and discussion. This integration starts to be made obvious by a growing number of recent researches. These researches were centered mainly on the study of the processes of teaching-learning and on the evaluation of teaching sequences integrating the ICT.

Karsenti and Larose (2005) located the question of the pedagogical integration of ICTE in terms of a larger scientific issue concerning the cognitive foundations, epistemological and pragmatic of the work of teachers and their training. Zellweger (2005) estimated that the change of the traditional practices requires that teachers invest efforts to develop new learning methods. Moreover as emphasized Barrette (2009) an effective integration of the ICTE must be subordinate to an adequate reflection on the intentions and the pedagogical strategies.

To improve methodologies of teaching by providing the access to new information and communication technologies (ICTE), Marcel Lebrun (2011) measured mainly the pedagogical impact of a platform of e-Learning “iCampus” on the learning of students and on the professional development of teachers in higher teaching through an investigation carrying into 153 teachers and 1179 students, users of this platform. Marcel Lebrun showed the need for real training leading to an appropriation of the uses of a progressive digital acculturation in the studies.

For a better understanding of the articulation that exists between the level of technical mastery, the pedagogical-didactic designs and the integration of the ICT in teachers training, Baumberger, Perrin, Bétrix and Martin (2008) carried out an inventory of fixtures of the use of media tools and ICT among 41 trainers of the High pedagogical school (HEP) of the canton of Vaud in Switzerland. These researchers found that for a more beneficial use of technologies, the trainers must have a sufficient pedagogical and technical level and benefit from the accompaniment of a “coach” to use these tools in a way more made within the framework of their teachings.

In order to determine the obstacles and the difficulties among the students and the teachers of the superior at the introduction of the technological products within their information system, Bouderbane and Smakdji (2010) realized a survey of a sample of 15 teachers and 30 students from the Faculty of Science of the University of Constantine. The results of their study showed the need to an intelligent pedagogical management and an efficient scientific training of two pedagogical actors’ students and teachers of the technologies.

In Morocco, the integration of ICT in scientific higher teaching has been the subject of some studies that have attempted to identify the factors blocking the successful integration of ICT in teaching and learning of the scientific disciplines. Aamili and Chiadli (2008) carried out a study, with 40 teachers, on the integration of the ICT within the University Chouaïb Doukkali of El Jadida. These researchers showed that only 45% of the teachers use the ICT in their pedagogical practice. In the same way, a survey conducted by Droui and Kaaouachi (2010) with 58 professors of University Mohammed Premier of Oujda, revealed a prevalence of the lecturing and experimental teaching and an important limitation as for the integration and the use of the ICT in the teaching of sciences. This weak exploitation of the ICT within the university in Morocco was explained by the lack of equipment, the lack of teacher training to the use of the ICT and the scarcity of the studies at the national level, devoted to the strategies of their integration. Berrada and Chraïbi (2010) carried out a comparative study between two distance teaching experiments undertaken in two Moroccan academies (engineering school and Faculty of Science). The two devices proposed, are based on a socioconstructivist pedagogy supporting a learning centered on the student. Their results showed that the progressive and dynamic integration of a learning environment could facilitate the appropriation of the courses by the students of their institutions and would thus contribute to reduce the rate of failures and abandonment. These experiments also revealed several difficulties of technical, organizational and pedagogical aspects.

Internationally, several researchers have studied the impact of the use of the ICT on the teaching-learning process of physics with all its specificities as an experimental discipline and for which teaching requires to be carried out with a particular care based on the observation of facts and phenomena before modeling and mathematizing them.

To remedy to the conceptual problems of the students in optics, Benjelloun, Alami and Rebmann (2003) tried out the use of a Java Workshop of Geometrical Optics (JWGO) with thirty-one students in second-year of university physics-chemistry section in Morocco. The results of their study showed that the use of the JWGO reveals the difficulties of the students who do not correctly conceptualize the formation of the image of a point by a mirror.

In order to make the meetings of Science Laboratory more formative, Riopel, and Raîche Potvin (2008) developed a computerized environement of human learning which allows the students of classical mechanics to engage in scientific modeling process combining the experimentation computer-assisted (ExAO) and the simulation computer-assisted (SAO). The experimentation of the developed environment was carried out with several groups of students (67 students). The results revealed that these students engaged with a certain enthusiasm in a process of modeling utilizing inductive and deductive stages of reasoning, 68% of them succeeded in using the environment developed to obtain answers to questions concerning the scientific concepts approached beforehand in class as well as completely new concepts. In addition 93% of these students were shown more interested by the experiment utilizing the learning environment rather than the usual experiments.

The study of Jacquet, Georges, Gourdange, Michiels and Poumay (2012) related primarily to the satisfaction of the students of the 1st academic year facing a training site to solve problems in physics as well as its impact on their learning. These researchers set up at the university of Liege (ULg, Belgium) an online space helping the students to solve their problems of physics by breaking up the processes of resolution and by becoming acquainted with detailed feedbacks, in

order to improve as well their comprehension of mechanics as the resolution of problems as such. The experimentation of physical space has been set up to 933 students in Medicine and Dentistry of ULg. The results revealed an important rate of connection (67%), but a large number of unique connections (36%). The objective and subjective data indicated that the physical space is useful for the students and it helps them to progress.

Bouchaïb and Benjelloun (2011) identified the conceptual difficulties encountered by the students of first university cycle in the field of electrostatics. They tested, three consecutive years, the resources relating to the electrostatic module of the open access site *University of Science Online*[1] *(UNISCIEL)* with students of the first year of preparatory classes for engineering schools (CPGE). They concluded that the integration of these resources in a situation of tutored auto-learning allows these students to gain the maximum of profit from the activities suggested by the site and produces a cognitive conflict, even sociocognitive, thus supporting an effective learning for a better appropriation of the studied concepts. These researchers announced that a teaching meeting enriched by the UNISCIEL is tiring for a facilitator teacher who must and on his own ensure a technical and conceptual assistance for the students and follow the progression of the learning of the group. This scenarisation is only practical for small groups because the facilitator teacher must grant to each student a minimum of time for an effective learning.

Guennoun and Benjelloun (2014) carried out a study exploring the perceptions of 151 Moroccan scientific students of engineer level cycle (3rd and 4th academic year) of the exploitation of the ICT in the courses of physics. Their study showed that the success of the physics learning courses using ICT requires a high motivation for university students to learn, observe and simulate at the same time a course of physics by the means of the ICT. It is necessary that the university students have a (self) training allowing them to acquire the necessary skills to learn with new technologies. Indeed, their results show that a relevant integration of the ICT in adequate situations of learning, centered on the needs for the students, requires a development of the more detailed demonstrations in the board during the meetings of the course.

To verify if the integration of the ICT could contribute to the improvement of the physical learning courses and more precisely of electricity, we carried out a study which first of all consist in determining the perceptions that the first-year university students (SMP spinneret) have after learning a course of electricity integrating the ICT, then to explore the impact of these tools on the concentration and the motivation of the students to learn electrostatic and electrokinetic, then to evaluate the teaching practice and thus the most appropriate teaching mode for a better teaching-learning of the courses of electricity and finally to raise the difficulties encountered during the integration of these tools in teaching, whether it is for the teachers or the students.

PROBLEMATIC AND THEORETICAL FRAMEWORK

Previous research into didactic of sciences showed that the students have problems of assimilation of certain concepts in physics and more particularly in electricity. Engelhardt and Beichner (2004); Kock, Taconis, Bolhuis and Gravemeijer (2011) indicated that the students in physics try to learn and understand many theoretical concepts, often without much success. They frequently find problems about the phenomena of electrical circuits. Rainson and Viennot (1998) proved that the students meet obstacles in the construction of the concepts of electric load and field. Mark Cosgrove (1995) noted that the students find the scientific conceptions concerning the electrical circuits difficult to assimilate. Bouchaïb and Benjelloun (2011) showed that the students have especially obstacles relating to the concepts of the electrostatic field created by a concentrated loading and principle of superposition of fields created by two concentrated loadings. In a Faculty of Science of education in Canada, Métioui and Trudel (2007) studied the explanations of the electrostatic phenomena advanced by students in 3rd academic year. On this subject, they questioned these students on some phenomena of electrostatics, like the formation of the flash and the interaction between rubbed bodies, also like on the utility and the dangers associated with electrostatics. These authors noted that the majority of the explanations provided by the students were false. Furió and Guisasola (1998), as for them, studied the reasoning of the Spanish students concerning the electrostatic field. They raised a confusion of the part; 46% of the first-year university students concerning the electrostatic force and the electrostatic field. To cure the difficulties of learning of the students in electricity and to make his learning more attractive and more motivating, we thought of integrating the ICT in the courses of electrostatics and electrokinetic.

The objective of our work is to determine the perceptions of the students relative to this kind of pedagogical innovation, to evaluate the added-value which the ICT bring to the learning of the students in electricity, to raise the obstacles met during the integration of these tools and to identify the teaching practice as well as the mode of teaching most adapted for a better teaching-learning of this subject.

Research questions

The questions in which our study is interested are the following ones:

- What impacts have the PPT presentations on the motivation and the learning of the students in electrostatics and electrokinetic?
- What are the difficulties encountered during the integration of the ICT for the teaching of this course of electricity?
- Which is the most adapted pedagogical practice for a better teaching-learning of this course?
- Which is the most adapted mode of teaching for a successful teaching-learning of this course?

[1] http://www.unisciel.fr/

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METHODOLOGY

The contents of the course of electricity (electrostatic and electrokinetic) exempted in first year of the science spinneret licence of the physical subject treat thoroughly the following topics:

- Concept of electric charge,
- Distribution (linear, surface and volume) of load,
- Electrostatic force, field and potential created by various electric charge distributions,
- Theorem of superposition, theorem of Gauss,
- Electrokinetic: equations of Kirchhoff, theorem of Thévenin and theorem of Norton.

The hourly volume of this course is 20 hours which are associated 12 hours of directed work and 10 hours of practical work.

We proposed to the students a handout taking again the totality of the taught course. The lecture was given using Power Point presentation, carefully realized, including the diagrams and figures necessary to the illustration of the taught contents. We downloaded starting from free websites of the filmed experiments which we presented. These experiments are of two types and highlight the load by friction of an initially neutral body and the repulsion or the attraction respectively of the same load signs or opposite signs. We illustrated by these experiments the contents of the corresponding courses during their teaching. The simulations could not be integrated into our course because we could not download them or record them. Furthermore, our amphitheaters did not have, during the period of this teaching, an internet connection in order to view these simulations directly on the Internet.

However the students were invited to consult the site of the University of Sciences Online (*UNISCIEL*) to visualize the various filmed experiments and simulations in order to better understand the abstract concepts of this course.

Presentation of the questionnaire (Annex)

Our questionnaire (See the Annex) relates to the perceptions of 122 students profiting from a teaching of the course of electricity (electrostatic, electrokinetic) is mainly centered on:

- Impact of the use of the ICT on the facility of acquisition and control of the difficult concepts in physics in the first year university students.
- Impact of the use of the Power Point presentations on the learning of the students.
- Impact of the use of the Power Point presentations on the concentration and the motivation of the students.
- Impact of the use of websites outside the teaching sessions on students learning.
- The point of view of the students on the most appropriate pedagogical practice for a better learning.
- The point of view of the students on the most suitable teaching mode (traditional or integrating the ICT) for a better learning.

The average duration for the award of this questionnaire is 15 minutes.

Data analysis method

We collected 122 responses from students enrolled in the first year of the science sector of physical matter (SMP) at the University Sidi Mohammed Ben Abdellah, Faculty of Sciences Dhar El Mahraz - Fez (Morocco).

We carried out quantitative statistical analyses with the data collected using the software sphinx. The open-ended questions, aiming at obtaining additional precise details and standard comments on the advantages and the limits of the integration of the ICT in the course of electricity, were the object of a qualitative analysis.

RESULTS AND DISCUSSION

1. Use of the ICT in the scientific courses within the university:

Table I shows the frequency of use of the ICT in the scientific courses at the students of the 1st academic year (SMP spinneret).

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Table I. Scientific material courses were exempted using the ICT

Module	Frequency
Electricity	100%
Chemical reaction	50,8%
Thermochemistry	50,8%
Chemical bonding	39,3%
Atomistic	38,5%
Algebra 1	32,0%
Optic	24,6%
Mechanic	20,5%
Algebra 2	19,7%
Thermodynamic	18,0%
Analysis 1	9,8%
Analysis 2	8,2%

In general, we note an important rate of use of the ICT in the teaching of the first year university of the science spinneret of the physical matter (SMP).

It should be noted that 100% of the questioned students attended our course of electricity presented by the ICT, which undoubtedly means that these students have perceptions concerning this mode of teaching.

2. Added value of the ICT in physics courses

Table II shows generally the students perceptions of the physics courses integrating the ICT:

Table II. Student perceptions of the added-value of ICT in physics courses

Perception_Use_ICT_physics Courses - Did the physics courses integrating the ICT facilitate to you the acquisition and the control of the difficult concepts in physics?			
Attitude	**Percentage**	**Standard comments**	**Percentage**
Favorable	**54.1%**	The use of ICT facilitates the acquisition of the phenomena and the physical laws while making the course clear and more comprehensible.	**9%**
		The use of the ICT helps to better understanding the abstract notions of the course.	**3.3%**
		The use of the ICT supports the learning while more benefitting from the teacher's explanations lasting the sitting of the course.	**2.5%**
		The use of the ICT helps to establish the link between the scientific studies and the experimental practice.	**1.6%**
		Not justified favorable attitudes	**37.7%**
Unfavorable	**45.9%**	The use of the ICT disadvantages the learning, the demonstrations detailed in the board remain essential for an appropriation of the difficult concepts in physics.	**9.8%**
		The use of the TIC just accelerates the presentation of the course, it does not promote a clear transmission of the concepts.	**6.6%**
		The use of the ICT makes the course tedious and that decreases the concentration and the motivation to follow it.	**1.6%**
		Not justified unfavorable attitudes	**27.9%**
Total			**100%**

It appears clearly that the use of the ICT in the physics courses favors for more than half of the students (54.1%) the comprehension and the control of the difficult concepts in physics and increases their interest to learn this matter. On the other hand 45.9% of the questioned students deplore this use, they declare a nuisance, a deconcentartion, a demotivation and an ambiguity during the teaching sitting. 9.8% among the latter insist on the detailed demonstrations in the board considering the complexity of the matter.

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The results of this study illustrate that the ICT facilitate the acquisition and the control of the abstract notions of the physics courses and help a significant number of the students to establish the link between the courses and the experimental practice. However, it clearly appears that the demonstrations detailed in the board remain essential during the sitting of the course since they facilitate to the young students the comprehension of the formulas and of the physical laws and push them, according to their declarations, towards an effective learning.

This part approaches the uses of the ICT in physics in a total way, the following parts will have more specific results to the use of the ICT in the course of electricity.

3. Reality of the integration of the ICT in in the course of electricity and attitude of the students

3.1 Students perception of the added-value of the Power point Presentations in the course of electricity

We presented the course of electricity (electrostatic + electrokinetic) in the form of the Power Point presentations (PPT) then we taught this course accompanying it by a duplicated lecture note. The taught contents were presented in different forms of representation (Definitions, Theorems, formulas, demonstrations, illustrative diagrams and video clips) which are useful for the comprehension of the abstract concepts in electricity.

Table III Shows perceptions of the scientific students of the 1st year university vis-a-vis this mode of teaching:

Table III. Student perceptions of the use of the PPT in the course of electricity

Perception_Use PPT_Course of electricity - Did the given course of electricity using the power point presentations allow you a better learning during the teaching sitting?			
Attitude	**Percentage**	**Standard comments**	**Percentage**
Favorable	**48,4%**	PPT help to advance more quickly in the course and to learn more during the sitting of teaching.	**4,9%**
		PPT increase the motivation to follow this kind of course while benefitting more from the explanations of the teacher.	**3,3%**
		PPT facilitate the learning of the course of electricity	**1,6%**
		PPT make the course clearer and well organized, they allow an integral assimilation of the contents of the course.	**1,6%**
		Not justified favorable attitudes	**36,9%**
Unfavorable	**51,6%**	PPT just accelerate the presentation of the course and decrease the concentration to follow it.	**5,7%**
		PPT make the course more complicated and incomprehensible during the sitting of teaching.	**3,3%**
		PPT do not allow an integral assimilation of the contents of the course, the demonstrations in the board remain quite necessary.	**3,3%**
		PPT in electricity make the course tedious and disadvantage the learning.	**0,8%**
		Not justified unfavorable attitudes.	**38,5%**
Total			**100%**

These results show that our course of electricity presented by the PPT is perceived by 48.4% of the questioned students, as easy to assimilate, better structured, well organized, motivating and more comprehensible. However these presentations are considered less effective for 51.6% claiming a complication, a disassimilation, and a brief explanation of the knowledge taught as well as a devolution and a boredom during the teaching sitting. The latter claim the complete development in the board of the demonstrations which causes the mathematical relations.

3.2 Use of PPT and the motivation of the students in the course of electricity

Table IV indicates the impact of PPT on the motivation of the students to learn the course of electricity:

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Table IV. Impact of the use of PPT on the motivation of the students

Impact_Use PPT_ Students motivation - Does the course of electricity given in this manner have allowed you to take an active part and to ask more your questions during the course?			
Attitude	**Percentage**	**Standard comments**	**Percentage**
Favorable	**52,5%**	The use of PPT helps to benefit fully of the remaining time to ask more questions and to do more exercises of applications during the sitting of teaching.	**16,4%**
		Not justified favorable attitudes	**36,1%**
Unfavorable	**47,5%**	The use of PPT just accelerates the presentation of the course and it is impossible to follow the rhythm of the professor.	**4,1%**
		The use of PPT makes the course tedious and it is demotivating to assist and to follow it.	**2,5%**
		Not justified unfavorable attitudes	**41%**
Total			**100%**

The results of this table show well that the students of the 1st year university do not adopt all the same attitudes concerning this mode of teaching of the course of electricity. However the integration of the ICT in this kind of course can offer a more motivating and more complete teaching to 52.5% students avid of innovation and resisting monotony.

3.3 Students and websites in link with the contents of the course of electricity:

The results of this study (table V) show that a good part of students (62.3%) did not reach during their training and apart from the sitting of teaching at websites in link with the contents of the course of electricity and in particular to *UNISCIEL* site of the university online that we suggested to them during this teaching. The analysis of their unfavourable justifications makes it possible to observe the following reactions:

Table V. Frequency of use of the websites in link with the contents of the courses of electricity for students in the 1st academic year.

Frequency_use _Course_Site - Have you consulted online sites related to the course of electricity to deepen your knowledge?			
response	**percentage**	**justifications**	**percentage**
Yes	**37,7%**	Not justified favorable attitudes	**37.7%**
No	**62,3%**	The sites must be suggested by the professors.	**6.6%**
		Lack of time to consult relative sites of the course of electricity.	**5.7%**
		Lack of means to consult relative sites of the course of electricity.	**4.9%**
		The Handout reiterating the essence of the course is enough sufficient to learn electricity.	**4.9%**
		The course of the professor seen in the teaching sitting is rather sufficient.	**3.3%**
		The traditional book is the best means to look further into knowledge in electricity.	**0.8%**
		Not justified unfavorable attitudes.	**36.1%**
Total			**100%**

These results reflect that 62.3% of the university students do not use the digital resources available on the Web and explain that by a lack of means and time and are satisfied with the teacher's course and the handout made available.

3.4 The most appropriate pedagogical practice for a better learning of the course of electricity

The objective of this part is to explore perceptions of the students relating to the learning of the course of electricity through ICT and to evaluate the most appropriate pedagogical practice for a better teaching-learning of electrostatic and the electrokinetic.

Table VI. Point of view of the students on the most adapted pedagogical practice for a better learning of the course of electricity.

Appropriate practice _course of electricity - How do you prefer to have a course of electricity?	
Favored pedagogical practice	**Percentage**
Classic given on the board without handout	**13.9%**
Given entirely on the board and with handout	**27.0%**
Presented using power point + handout and demonstrations on the board.	**12.3%**
Presented using power point and integrating the video experiments + handout and demonstrations on the board.	**40.2%**
Presented using power point and integrating the video experiments + handout and the explanations of the teacher.	**6.6%**
Total	**100%**

The results of our investigation show well that, in a course of electricity, the use of the power point presentations integrating the video experiments accompanied by detailed demonstrations in the board is the most favored pedagogical practice by the majority of the students (40.2%). These students benefit initially from the PPT that enrich and energize the course content, the video clips presenting experiments relating to the course and the demonstrations in the board showing its contents, while keeping the totality of the contents taught on handout.

3.4 Students and the most adapted mode of teaching for a better learning of the course of electricity

The objective of this part is to evaluate the most adapted mode of teaching for a better learning of the course of electricity.

Table VII. The most adapted mode of teaching for the first-year university students of the SMP spinneret.

Teaching_Mode - For a better learning of electricity are you for:	
Favored mode of teaching	**Percentage**
A traditional teaching	**41.0%**
A modern teaching integrating information and communication technologies (ICT)	**59.0%**
Total	**100%**

The results of table VII show well that the questioned students do not all have the same vision concerning the most adapted mode of teaching for a better learning of this subject. These results are favorable for a hybrid teaching (integration of ICT in the sitting of the course of electricity + detailed demonstrations on the board), this hybrid mode of teaching can generate significant effects as for the comprehension of the concepts, the phenomena and the physical laws.

4. Statistical study

To confirm the declarations of the students and to show the coherence of their answers concerning their perceptions of the integration of the ICT in the course of electricity, we carried out two tests of independence of Chi2 for cross tables.

4.1 Test1: Relationship between the teaching practice opted by the students and their perception of the use of PPT in the course of electricity.

We studied using the Chi2 independence test, the relation between the pedagogical practice favored by the scientific students of the first year university and the perception they have of the use of PPT in their courses of electricity (Table VIII). It its then to study the dependence between the two following variables:

- **Perception_ Use PPT _ Course of electricity** : The perception of the students of the use of PPT in the course of electricity.

- **Appropiate_practice_course of electricity** : Pedagogical practice supported by the students for a better teaching-learning of the course of electricity.

We have drawn the following working hypotheses:

- **H0 :** The pedagogical practice opted by the students in the course of electricity does not depend on their perception of the use of PPT in this course.

- **H1:** The pedagogical practice opted by the students in the course of electricity depends on their perception of the use of PPT in this course.

The results of the test1 of Chi2 are summarized in tables VIII and IX:

Table VIII. Dependence of pedagogical practice opted by the first year university students and their perception of the use of PPT in the course of electricity.

Perception_ Use PPT _ Course of electricity / Appropiate_practice_course of electricity	Favorable	Unfavorable
Classic given on the board without handout.	**4.1%**	**9.8%**
Given entirely on the board and with handout.	**0.0%**	**27.0%**
Presented using power point + handout and demonstrations on the board.	**9.0%**	**3.3%**
Presented using power point and integrating the video experiments + handout and demonstrations on the board.	**28.7%**	**11.5%**
Presented using power point and integrating the video experiments + handout and the explanations of the teacher.	**6.6%**	**0.0%**
Total	**48.4%**	**51.6%**

Table IX. Results of the test1 of Chi2

Chi- square Value	The degree of freedom : ddl	Interval of critical probability : 1-P	Decision	The accepted hypothesis
56.08	4	99.99%	The dependence is very significant	H1

In this case the test1 of Chi2 showed a very significant dependence between the teaching practice supported by the first-year university students and their perception of the use of PPT in the course of electricity. These results confirm the rejection of H0 hypothesis and the maintaining of H1 hypothesis. They show that 40.2% of the students (of whom 28.7% are for the use of PPT in the courses of electricity and 11.5% are completely against this use) opt for a hybrid approach of teaching based on a presentation of the course of electricity using power point integrating the filmed experiments accompanied by demonstrations in the board illustrating the course content and a handout reiterating the essence of this course.

4.2 Test2: Relation between the impact of PPT on students motivation to follow a course of electricity and their points of view on the most adapted mode of teaching for a better learning.

To verify the relation between the mode of teaching supporting the learning of the students in electricity and the impact of PPT on their motivation to learn, we carried out the Chi2 independence test (Table X) after the crossing of the following variables:

- **Impact_Use PPT_ Students motivation:** Impact of the use of PPT presentations on the students motivation to learn electricity.

- **Teaching_Mode:** The most appropriate mode of teaching for a better teaching-learning of the course of electricity.

We formulated the following working hypotheses:

H'0: The impact of PPT on student motivation to learn electricity does not influence their choice of the most appropriate mode of teaching for a better learning of electricity.

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H'1: The impact of PPT on student motivation to learn electricity influences their choice of the most appropriate mode of teaching for a better learning of electricity.

The results obtained are summarized in Tables X and XI:

Table X. Dependence between the mode of teaching supporting the learning of the students in electricity and their motivation to learn electricity by the means of PPT.

Impact_Use PPT_ Students motivation / Teaching_Mode	Favorable	Unfavorable	Total
A traditional teaching	10.7%	30.3%	**41.0%**
A modern teaching integrating information and communication technologies (ICT)	**41.8%**	**17.2%**	**59.0%**
Total	**52.5%**	**47.5%**	

Table XI. Results of the test2 of Chi2

Chi- square Value	The degree of freedom : ddl	Interval of critical probability : 1-P	Decision	The accepted hypothesis
23.78	1	99.99%	The dependence is very significant	H'1

The results of this test2 show a very significant dependence between the impact of PPT on the motivation of the students to learn electricity and their choice of the mode of teaching supporting this learning. These results confirm the rejection of the H'0 hypothesis and the maintenance of the H'1 hypothesis.

The crossings of table X illustrate well that among the 47.5% of students estimate that PPT disadvantage and demotivate their learning. 30.3% prefer a traditional teaching. Whereas among the 52.5% of students claiming that PPT increase their motivation and help them to actively participate and to ask more questions during the teaching sitting, 41.8% of them choose a modern teaching of this course integrating the ICT.

These results show that the integration of the ICT in the course of electricity can offer a more motivating and more comprehensive teaching and could carry out 41.8% of the students towards an effective learning. However a hybrid learning mode can further motivate the questioned students and can facilitate their acquisition and their mastery of the difficult concepts in electrostatic and electrokinetic.

5. Difficulties and final observations of the teacher after teaching the course of electricity using the ICT

The reports which are risen after teaching this course of electricity using these tools are the following: First of all, an initial refusal of a part of the students (as confirm it the results of the answers to the questionnaire) to the power point presentations, then a general adhesion with the filmed experiments.

The duration to teach the same contents is shorter than with the classical method. So, we implied the students more during this course by giving them exercises and also while answering their questions. Moreover, the application exercises were integrated immediately after teaching of each part of the course. In addition we developed, on the board, the demonstrations detailed for the parts where the students find it necessary.

We found this method much exhausting, because we must prepare carefully and, in advance, the handout of the course, the Power Point presentations, choose the filmed experiments to present and coordinate with the duration allocated for teaching. We had during the majority of the sitting to take again demonstrations or developments in the board because it is noted that the students follow better and seen to better understand when the developments of the demonstrations of all the equations is made parallel with the explanations. There is probably a link effect between the explanations and the writing of the scientific equations on the comprehension of notions subject of the study.

It was not obvious to measure the impact of this method of teaching on the results of evaluation of the students. Indeed, manpower of the first-year students SMP is very important, of this fact two professors dispensed the teaching of this course. Each professor has the same sections of students for all the teaching period. During this year of experimentation of this method, our colleague ensured a classical teaching on the board. However, the students do not have any obligation to assist in a precise section because their presence was not being controlled. This ruled out any possible comparison of results of the students who have taken, a priori, our method with those of students who have followed the traditional method. We were therefore limited to evaluate the perceptions of certain students who really followed our course.

CONCLUSION

In the end of our investigation, it comes out from it, initially, that the course of electricity presented by the PPT is perceived by 48.4% of the students questioned as easy to assimilate, structured, well organized, better justifying and more comprehensible. However a quite considerable rate of students (51.6%) considers these presentations less effective and declares a compilation, a dissimilation, a short explanation of the knowledge taught as well as a devolution and a trouble during the sitting of teaching. This attitude is mainly due to a lack of motivation of these students as for the use of the ICT.

Our study also showed that the most favored teaching practice by 40.2% of surveyed students (28.7% are for the use of PPT in the electrical courses and 11.5% are against this use) lies in the appropriate use of power point presentations by integrating filmed experiments accompanied by detailed demonstrations on the board and a handout reiterating the essence of the course of electricity.

These results help us to deduce that the teaching of electricity requires a suitable use of the ICT based on an adequate pedagogy resting on a hybrid teaching thus supporting the motivation of the students for a better learning.

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ANNEX: QUESTIONNAIRE

Evaluation of the impact of the use of the TIC in higher teaching of physics « Case of a course of electricity »

This questionnaire is anonymous and does not return within the framework of your evaluation. Thank you to freely express your opinion.

Question1: During your training in which subject did you take a course integrating Information and communication technologies ICT (Presentation of the course using power pointt + simulations and video experiments)?

Physics1

☐ Thermodynamic

☐ Mechanic

Chemistry1

☐ Atomistic

☐ hemical bonding

mathematics1

☐ Algebra1

☐ Analysis1

Physics2

☐ Electricity

☐ Optic

Chemistry2

☐ Chemical reaction

☐ Thermochemistry

Mathematics2

☐ Algebra2

☐ Analysis2

Question 2: Did the physics courses integrating the ICT facilitate to you the acquisition and the control of the difficult concepts in physics?

☐ Yes ☐ No

Justify your answer: ----------

Question 3: Did the given course of electricity using the power point presentations allow you a better learning during the teaching sitting?

☐ Yes ☐ No

Justify your answer: ----------

Question 4: Does the course of electricity given in this manner allow you to take an active part and to ask more questions during the course?

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☐ Yes ☐ No

Justify your answer: ----------

Question 5: Have you consulted online sites related to the course of electricity to deepen your knowledge?

☐ Yes ☐ No

If not why ?----------

Question 6: Have you consulted online sites to work exercises or typical examinations in electricity?

☐ Yes ☐ No

If not why ?----------

Question7: Do you have a personal computer?

☐ Yes ☐ No

If not why ?----------

Question 8: Do you have an internet connection in your residence?

☐ Yes ☐ No

If not why ?----------

Question 9: How do you prefer to have a course of electricity?

- ☐ Classic given on the board without handout
- ☐ Given entirely on the board and with handout
- ☐ Presented using power point + handout and demonstrations on the board.
- ☐ Presented using power point and integrating the video experiments + handout and demonstrations on the board.
- ☐ Presented using power point and integrating the video experiments + handout and the explanations of the teacher.

Question 10: For a better learning of electricity are you for:

- ☐ A traditional teaching
- ☐ A modern teaching integrating information and communication technologies (ICT)

Thank you for having answered to this questionnaire