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ICT Impact on the Learning and Teaching Practices: Some Concepts in Biology, Respiratory, Absorption and Digestive Systems

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Abstract: ***Everyone is aware of the important role and the considerable educational interest in the use of information and communication technology in teaching (ICTT). It has a transversal and generalized use in the teaching/learning process. Thus, it was necessary for Morocco to integrate ICT in a pedagogical system and use it as a didactic tool. To carry out this research, we have devised pedagogical scenarios that integrate three digital resources named« RN.resp16 » , « RN.dig16 » et « RN.abp16 »the goal of this integration is to evaluate the comprehension and assimilation level of three biological concepts namely respiration, digestion, and intestinalabsorption. For data collection, we have utilized a questionnaire, an observation grid, and three tests; each one has been filled out by students by the end of the lesson. The sample of this study would be two classes of middle school, the first and the third year. The main results of the tests in relation to the use of digital resources « RN.resp16 », « RN.dig16 »and« RN.abp16 »have shown that: a) The results of our research have shown that 82% of teachers face problems when explaining certain biological terms such as respiration, digestion and absorption. It also showed that most of these teachers 98% agreed about the use of ICTT to improve the students' comprehension and the assimilation of difficult concepts. b) The use of ICTT improves students' behavior vis-à-vis information (attention, calm, participation…) c) Decrease in the number of students with very low marks(-8,15% resp ; -7,69% dig and -9 ,81% abp), and low marks (-15,63% resp ; -17,95% dig and -29,08% absp) d) increase in the number of students with average marks (+2,55% resp ; +7,69% dig and +3,95% absp) good marks (+10,53% resp ; +12,82% dig and +16 ,97% absp) and very good (+11,65% resp ; +5,13% dig and +16,05% absp). These results show the importance of ICTT in improving comprehension and assimilation of biological terms.***

Keywords: ICTT, «RN.resp16», «RN.dig16», «RN.abp16», Life and Earth sciences.

1. Introduction

Information and communication technology is a set of technology based on computer sciences, microelectronics, the telecommunication (especially networks), the multimedia and the audiovisual which, combined and interconnected all together, allow searching, storing, processing and transmitting information in the form of data of various types (text, sound, still images, video images) [1].

The data of text, sound, still image, motion picture, video, software and other information and communication technologies (ICT) are phenomenal tools and digital resources "RN" most used in teaching and learning. They can search, store, process and transmit information and facilitate interactivity between people and between people and machines [2]-[3].

The tools are defined as a set of equipment designed and used to produce, process, store, exchange, classify, retrieve and read digital documents for teaching and learning purposes [4]. The ICT has a transversal and generalized use in the teaching/learning process. Therefore, it is important to integrate ICT in the educational system to become a didactic tool in education.

The profound change that the international educational scenery has known made it necessary for the Moroccan educational system to seek the integration in the information and knowledge society, throughout the generalization of information and communication technology in the learning/teaching process [5].

In this sense, Morocco, like other developing and western countries, has understood the importance of the use and the integration of ICT in its educational system. As a result, the Moroccan government has adopted, since 2005, a program named « GENIE » [6],this program aims atgeneralizing this technology in order to integrate it in the educational and training system.

ICT then become,on the one hand, a reality as a tool that enables teacher's pedagogical and methodological practices to develop, a vector that modernize and accelerate human and economic development on the other hand. Major national projects were launched in Morocco to disseminate, facilitate and showcase an educational culture that promotes ICT within the Moroccan educational system.

Using ICT for educational purposes does not mean that technological devices replace the teacher[3]-[7]; the observations made on this subject have shown that ICT

never replaces the teacher. Thus, it is a matter of new tools, additional didactic tools that are available for the teacher to facilitate the students' learning. The educational use of ICT can be classified into the following fields:

- Searching for useful information for the institution, instilling and developing a teaching/learning competency;
- Acquiring ICT concepts and methodologies associated with daily lessons;
- Producing, creating and using knowledge and skills to produce educational outcomes and improve new competencies;
- Areas of communication and sharing that create an educational, participatory, and collaborative space between all the agents of education;
- Field of organization and planning for the teacher which enables him/her to better plan, organize his/her role in the classroom as well as the individual follow-up of the learners.
- Our motivation for this research stems, on the one hand, from our awareness of the important role of ICT in the teaching practices in SVT because it improves the teaching-learning process among both teachers and learners. On the other hand, because of many other reasons that we can state as follows:
- A great shortage of experimental equipment in the schools' laboratories ;
- An impossibility to authenticate some real phenomena (duplication of DNA, protein synthesis, antigen, antibodies….);
- A long duration of some phenomena that cannot be visualized at the real time (Subduction, life cycle of certain living beings, plant growth, immune system effect, ...);
- The danger or delicacy of certain experiments (chemicals, dissection equipment…);
- The huge number of students in the same class (impossible to conduct or handle the experiment with a crowded class,…).

For these reasons, our research revolves around the following question :what is the role of information and communication technology in the comprehension of certain terms in biology?

This study aims at analyzing how ICT can contribute to the improvement of the comprehension of certain terms in biology, the human body as an example. The problematic of this study lies in clarifying the role of ICT in drawing students' attention during the lesson, and revealing its importance in improving students' comprehension.

2. Methodology

This research focuses on the impact of the use of ICT on the improvement of comprehension and assimilation at the students.

To carry out this study, we have used a survey that contains questions, and an observation grid to be filled out by teachers involved in the research during the session, it also contains tests to be filled by students by the end of the lesson.

2.1. Targeted Sample

The targeted sample of this study consists of two classes (80 students) of 3rd year middle school to study the concept of digestion, two classes (80 students) of 3rd year middle school to study the concept of assimilation, two classes (80 students) of 1st year middle school to study the concept of respiration. The sample is randomly selected from the classes taught by teachers in public schools [8].

2.2. Digital Resource « RN. Resp 16 », « RN. Dig16», «RN. Abp16»

2.2.1.Digital ResourceResp 16

It is a digital resource in the form of videos (figure 1) addressed to 1st year middle school students. The videos' duration varies between 4 to 5 minutes and repeated in a period of 15 minutes.

Figure 1: Digital resource« RN.Res 16 »describinghuman respiration

2.2.2 Digital resourceDig 16

It is a digital resource in the form of Flash (figure 2) adressed to the 3rd year middle school students, repeated in a period of 15 minutes.

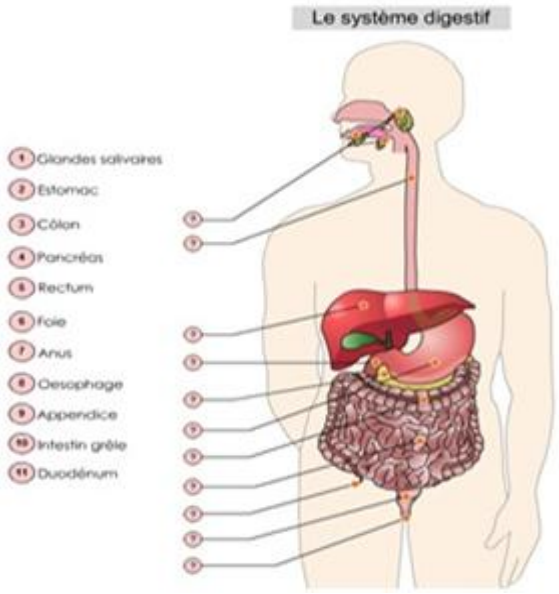

Figure 2: Digital resource« RN.Dig 16 »describing human digestion

2.2.3 Digital resource Abs 16

It is a digital resource in the form of a video (figure 3) of 3 minutes, addressed to 3rd year middle school students, repeated in a period of 15 minutes.

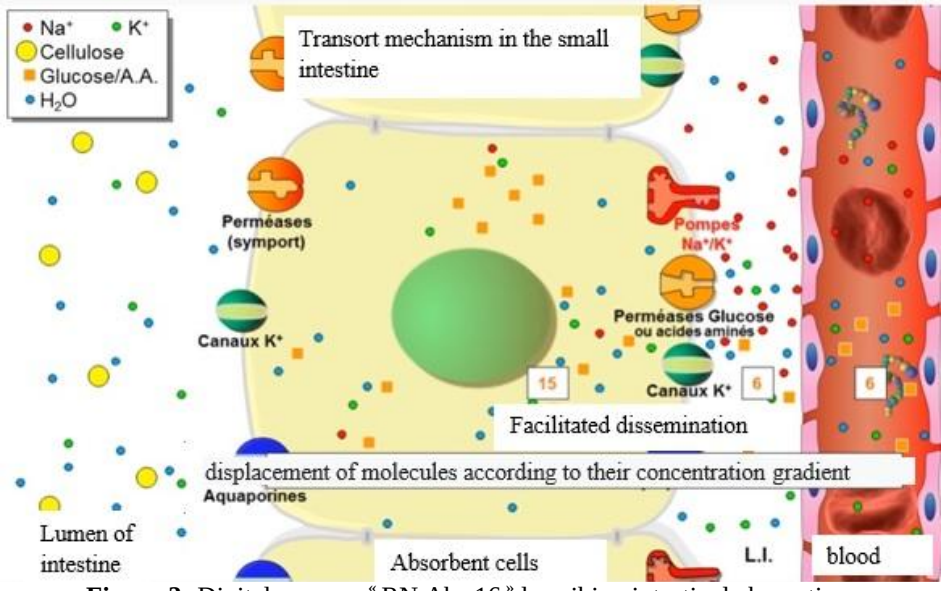

Figure 3: Digital resource« RN.Abs 16 »describing intestinal absorption

2.3 Collecting statistical data (survey, grid and tests)

We have conducted a survey questionnaire administered to teachers and contains the following items:

- Questions 1 to 3: reveal the biological concepts in the middle school program where the teachers find it difficult to explain such concepts to students, and situate the studied concepts (respiration and digestion) among those that pose a problem of comprehension and assimilation for students.
- Questions 4 to 15: prove the existence of a problem of understanding and assimilating the concepts of respiration in the living beings for the first-year middle school students, and that of human digestion for the third year middle school students [9].

The questionnaire was filled in by the teachers of Life and Earth Science in middle school, and who have at least one year of experience, in order to detect the maximum of problems in understanding the biological concepts in middle school program [10].

The use of the observation grid aims at revealing the impact of using ICT in teaching certain biological concepts on quietness, focus and participation of students during the session. That is why the prepared observation grid targeted clear answers for these main points that show clearly the level of comprehension among groups of students taught with and without ICT [11].

The observation grid was filled in in two different classes, the first is taught with ICT (class A) and the second without ICT (class B).

In order to measure the level of comprehension and make a reliable comparison between the two groups of students taught with and without ICT, three anonymous tests were prepared, the first is composed of 7 exercises intended for 1st year middle school students targeting the didactic sequence « respiration », and the two other tests consist of 10 questions geared to 3rd year middle school students targeting the didactic sequences related to digestion and absorption. The anonymity of the tests allowed us to get candid answers that faithfully reflect the students' comprehension of the sequence which is taught.[12].

The tests that contain different exercises: multiple choice questions and task-based situation, a study of the average of correct or wrong answers per question across the entire sample will be enough to detect whether the students have understood the lesson [13]

The tests will be administered to students after explaining the sequence and the students should answer the questions individually. Then, the tests will be corrected and the results will be gathered in a chart in order to process them [14]

2.4 Analysis and statistics

All the data collected during the observations and the administration of questionnaires are processed and analyzed by the computer software (Excel), the easiest, the most responding and the most known software among the majority of Moroccan teachers [15].

3. Results and Discussion

3.1. Questionnaire administered to middle school teachers

For problems faced by teachers when explaining certain terms in biology, we have found that 82% of teachers have problems opposite to 18%.

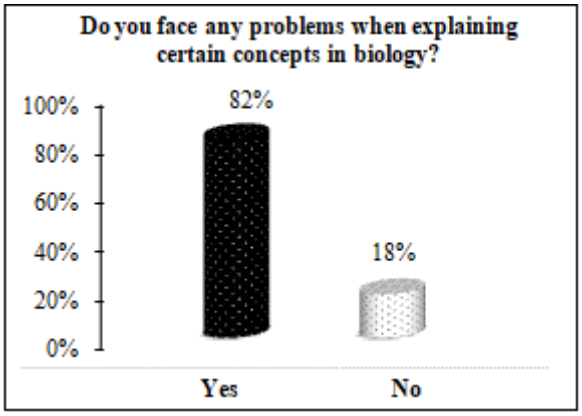

Figure 4: Results obtained from the questionnaire about problems found in explaining certain concepts in biology

For the type of problems, the teacher encounters, we have noticed that 40% of teachers marked the lack of tools for experiments, 32% stated the absence of data-show, 10% found that students don't have biological modeling, 4% face other problems, and 14% did not respond.

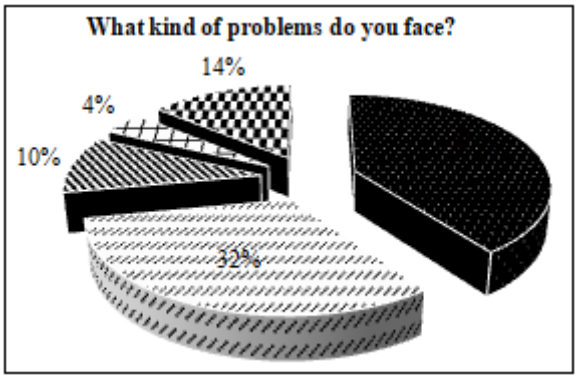

Figure 5: Results obtained from the questionnaire on the problems encountered by teachers

As for the lessons in biology that the students find difficult to assimilate, we noticed that 40% found respiration, 36% found immunology, 20% found digestion and absorption, and 4% responded with other lessons.

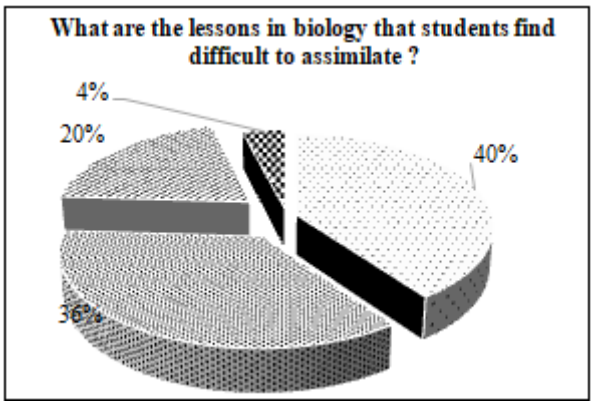

Figure 6: Results obtained from the questionnaire on the lessons in biology that students find difficult to assimilate

For the difficulties that students have in understanding respiration, 76% of teachers confirmed the existence of such difficulties, and 24% said the opposite.

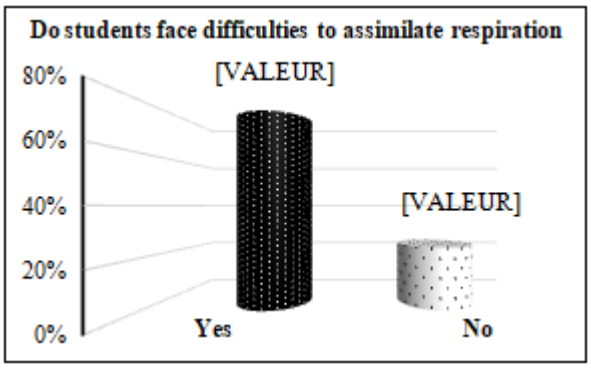

Figure 7: results obtained from the questionnaire on the existence of difficulties at students to assimilate respiration

Concerning the difficult concepts that students find to understand respiration, we noticed that 44% of teachers answered for gas exchanges, 34% for cellular respiration, 16% gave other answers, and 6% did not answer.

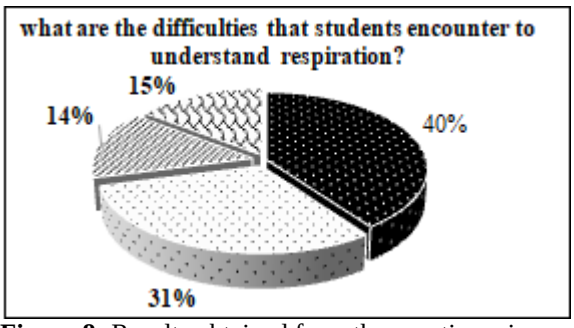

Figure 8: Results obtained from the questionnaire on difficulties that students encounter to assimilate respiration

Regarding lessons in biology, the majority of teachers 90% confirmed that the students find difficulties in the comprehension of the lesson of « Digestion and Absorption », while 2% (1/50) of teachers did not answer this question.

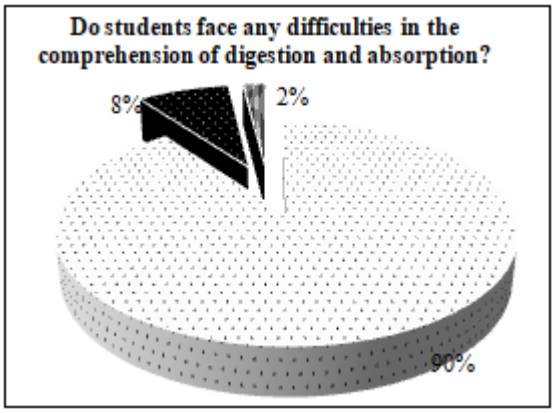

Figure 9: Results obtained from the questionnaire on the existence of difficulties at students to assimilate digestion and absorption

For digestion and absorption lesson, the teachers that confirm the existence of difficulties in understanding the lesson of«Digestion and Absorption» among students specified that thedifficulties are as follows:

- Misunderstanding of the word « Enzyme » and its functions.

- Difficulties in understanding absorption at the level of microvilli;
- The students are unable to understand that there is a passage of nutrients of light from the small intestine towards blood;
- Molecular simplification.

The results show that almost all the teachers 98% agreed on the use of ICT in facilitating the comprehension of biological concepts, except one teacher 2% who did not answer this question.

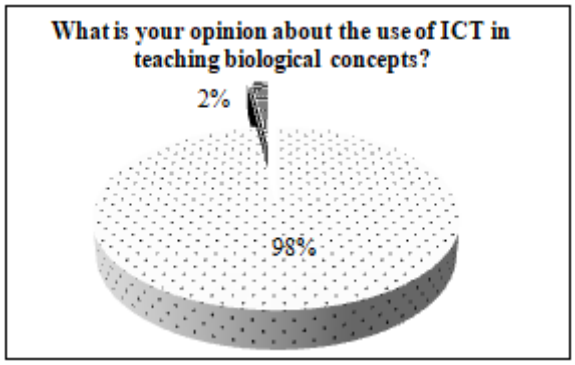

Figure 10: Results obtained from the questionnaire on the use of ICT in teaching biological concepts

Regarding the teachers' opinion on the use of ICT to facilitate the comprehension of the lesson of respiration, the teachers who answered the questionnaire are all for 100%.

The teachers' answers to the question related to the use of ICT in explaining the lesson of « Digestion and Absorption »; 98% are for, while 2% are against.

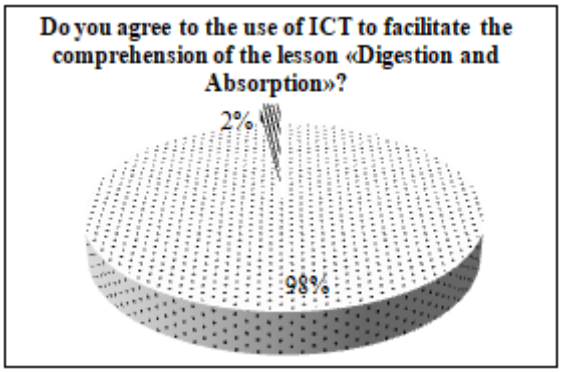

Figure 11: Results obtained from the questionnaire on the use of ICT to facilitate the comprehension of the lesson « Digestion and Absorption »

For the ICT role in solving comprehension and assimilation problems of certain biological concepts, 70% of teachers answered for very good, 26% for good, and 4% did not answer.

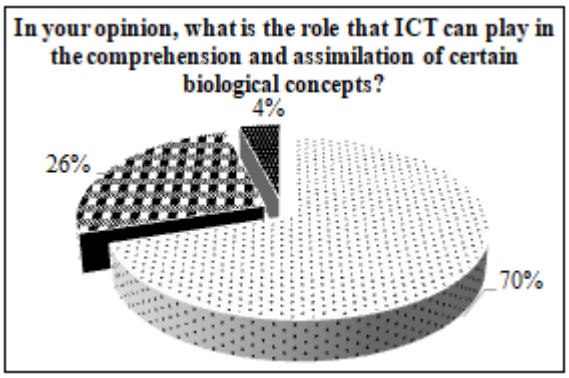

Figure 12: Results obtained from the questionnaire on the role of ICT in the comprehension and assimilation of certain biological concepts

As for the role that can be played by ICT in understanding and assimilating the function of human body apparatus, 68% of teachers answered for very good, 26% for good, and 6% for average.

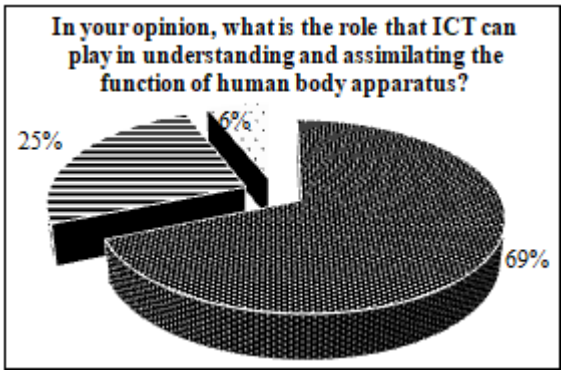

Figure 13: Results obtained from the questionnaire on the role that ICT can play in understanding and assimilating the function of human body apparatus

For the use of ICT by teachers to solve difficulties posed by the function of human body apparatus among students by the use of ICT, 48% have already tried and 52% did not try. 100% of teachers who answered with yes confirmed that the results after the use of ICT were very satisfying.

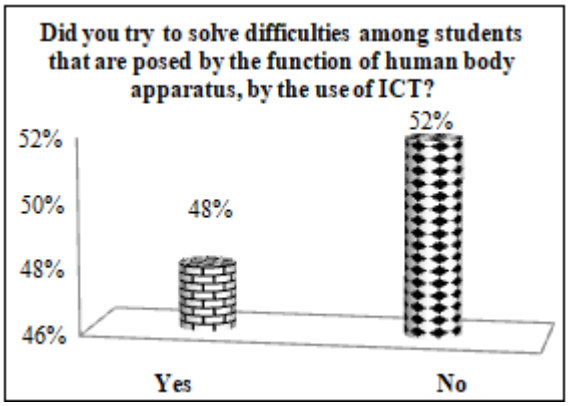

Figure 14: Results obtained from the questionnaire on trying to solve difficulties among students that are posed by the function of human body apparatus, by the use of ICT

For the use of ICT by the teachers to solve difficulties among studentsthat are posed bythe function of respiratory system in the lesson of respiration in different environments,

by the use of ICT, 40% of teachers have already tried while 60% did not try. 80% of teachers who have answered with yes confirmed that results of the use of ICT in the lesson of respiration in different environments were very satisfactory, and 20% of teachers confirmed that the results were satisfactory.

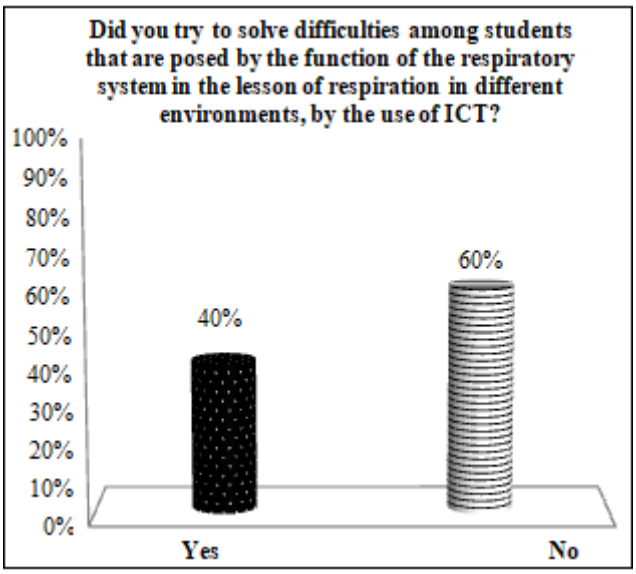

Figure 15: Results obtained from the questionnaire on trying to solve difficulties among students that are posed bythe function of the respiratory system in the lesson of respiration in different environments, by the use of ICT

For the use of ICT by the teachers to solve difficulties among students that poses the function of digestive system, by the use of ICT, 72% of teachers have already tried while 28% did not try. 100% of teachers who have answered with yes confirmed that the results after the use of ICT were very satisfactory.

Generally speaking, we can say that the results of the questionnaire show that:

- The majority of the teachers face problems with the explanation of biological concepts.
- The problems that teachers find to explain these concepts are as follows: lack of experiment tools, absence of Data-show, students don't have biological modeling…
- The teachers noticed that there are many lessons that are difficult to assimilate by students among which respiration represents 40%, immunology represents 36%, then digestion and absorption which represent 20%, and the rest found other lessons difficult.
- The majority of teachers (76%) have confirmed that the students encounter difficulties in understanding respiration, while only 24% said that the lesson was well understood.
- The teachers have confirmed that there are various concepts in respiration that the students have not understood, the important ones are: gas exchanges, which represents the highest percentage (44%), then cellular respiration…
- Most of the teachers 90% have confirmed that the students have difficulties in understanding the lesson « Digestion and Absorption ».
- According to teachers, the students find problems to understand absorption of nutrients at the level of the small intestine, molecular simplification of the enzyme and its functions.
- The majority of teachers 98% agreed on the use of ICT in order to facilitate the comprehension of biological concepts.
- The teachers who have answered the questionnaire are all 100% for the use of ICT to facilitate the comprehension of respiration lesson.
- 98% of teachers are for the use of ICT in the explanation of the lesson « Digestion and Absorption ».
- Most of the teachers (70%) are convinced that the role played by ICT in the comprehension and assimilation of certain biological concepts is very important.
- A considerable number of teachers (69%) are convinced that the role played by ICT in the comprehension and assimilation of the function of human body apparatus is very important.
- 40% of teachers have already tried to solve difficulties among students that are posed by the function of human body apparatus, by the use of ICT and 60% did not try.
- 100% of teachers that have already tried to solve difficulties among students that are posed by the function of human body apparatus by the use of ICT confirmed that the results after the use of ICT were very satisfactory.
- 72% of teachers have already tried to solve difficulties among students that are posed by the function of respiratory system in the lesson of respiration in different environments, by the use of ICT and 28% did not try.
- 100% of teachers that have already tried to solve difficulties among students that are posed by the function of respiratory system in the lesson of respiration in different environments, by the use of ICT confirmed that the results after the use of ICT were very satisfactory.

This research showed that certain concepts of biology pose a difficulty for students and the majority of teachers are convinced that ICT is important in this case. Moreover, teachers that have already tried to solve these difficulties by the use of ICT were very satisfied with the obtained results.

The results of this research motivated us to confirm the role of ICT in the lessons taught in this period and which represent a problem for the students to understand and assimilate, as the teachers have noticed.

3.2 Observation grid after the use of «RN.resp16», «RN.dig16», «RN.abp16»

During the lesson, besides the didactic tools, certain students' behavior can influence their understanding and assimilation of the studied concepts such as calmness, attention and participation. For this, we have decided to devise an observation grid by which we note during the session the effect of ICT on the students' behavior towards the studied concepts. The obtained results are gathered and represented in the following chart:

Table1: Representation of the results of the observation grid (- : weak ; ± : average ; + : good)

Theme		*Respiration*		*Digestion*		*Absorption*	
		Without ICT	*With ICT*	*Without ICT*	*With ICT*	*without ICT*	*With ICT*
Calmness	The studentsspeak	±	+	±	+	±	+
	Play with chairs or their supplies	±	+	±	+	±	+
	Keep quiet	-	+	±	+	±	+
The participation of students	Participate positively in the classroom	+	+	±	+	±	±
	Make effort	±	±	±	+	-	±
	motivated	±	+	±	+	-	+
	Answer the questions	+	+	+	+	±	+
	Ask questions					±	+
Attention	Follow the steps of the lesson	-	±	±	+	-	+
	focuscorrectly	±	±	±	±	±	+
	Follow the instructions	-	±	-	±	-	±
	Focus incorrectly	±	+	±	+	±	±
	Sleep in the classroom	-	-	-	-	±	-
	Manage to stayfocused	±	+	±	+	±	+

After analyzing the data gathered in this chart, we notice that there is an improvement in the behavior of students during the teaching of different parts of the lesson using ICT, they keep quieter, they are more attentive, and they better participate in constructing the lesson.

3.3 Tests after the use of «RN.resp16», «RN.dig16», «RN.abp16»

The tests are made in a way that examines students' level on the comprehension (multiple-choice questions, figure legends, drawings…) and assimilation (problem-solving situation).

The results of the tests are classified into five categories (Tab 2) in order to better compare the results of the two classes with and without ICT.

Table 2: Classification of the test's results

Mark	*category*	*Code of the category*
[0,7]	Verylow	1
[7,10]	Low	2
[10,13]	Average	3
[13,16]	High	4
[16,20]	Veryhigh	5

The following table represents information about the number of students (241 students in total), who answered tests related to different sequences that were taught.

Table 3: Representing the retrieve of tests according to the level

Schoollevel	*Group A*	*Group B*	*Lesson*
1st middle school	44	41	Respiration
3rd middle school	39	39	Digestion
	40	38	Absorption

3.3.1. Respiration in differentenvironments

The following table represents the results obtained by the first-year middle school class taughtwith and without ICT during the lesson of respiration in different environments.

Table 4: Representation of the results of the tests

Code of the category	*Number*		Percentage		Cumulative percentage	
	With ICT	Without ICT	With ICT	Without ICT	With ICT	Without ICT
1	5	8	11,36	19,51	11,36	19,51
2	6	12	13,64	29,27	25	48,78
3	14	12	31,82	29,27	55,82	78,05
4	10	5	22,73	12,20	79,55	90,25
5	9	4	20,45	8,8	100	99,05

The curve below represents the results of the two classes taught (without and with ICT).

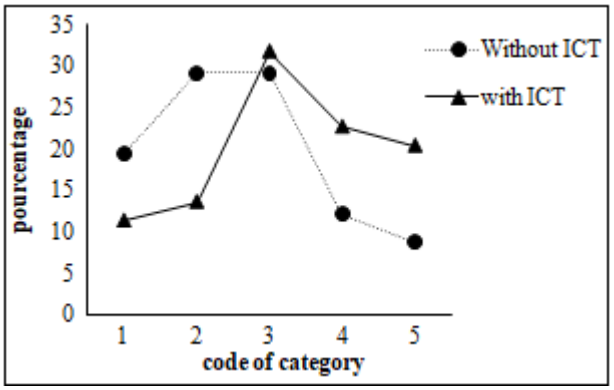

Figure 16: Results of the two classes taught without and with ICT (respiration lesson)

According to the shape of the two curves, we can classify the results into three parts:

- The first part between category 1 and 3: very low and low marks up to average mark but not included.
- The second part: average marks.
- The third part: from category 3 not included up to category 5, that is to say, high and very high scores.

For the first part, we notice that the curve without ICT is higher than the curve with ICT, we can say that the use of ICT could reduce the percentage of students under the categories very low (8.15% of difference), and low scores (15.63% of difference).

For the second part related to the average marks, we notice that there is a slight alteration (2.55%) marked with an

increase in the level of the class with ICT. For the third part that corresponds to the categories of high and very high scores, we noticed that the curve of the class with ICT is higher than that of the class without ICT, this shows that there is an increase in the number of students under these categories; (10.53% of difference) in the category high score and (11.65%) in the category very high.

These results confirm that the use of ICT has led to positive changes at the level of students' grades (decrease in the number of categories very low and low scores, and increase in the number of categories high and very high scores), this reflects the positive effort of ICT in understanding and assimilating the respiratory system in the lesson of respiration in different environments for the first year middle school students.

3.3.2. Human digestion

The lesson « human digestion » was taught to a group of third year middle school students with and without using ICT, and the results were presented in the chart below (Tab 5).

Table 5: Representation of the results of the tests

Code of the category	*Number*		Percentage		Cumulative percentage	
	With ICT	Without ICT	With ICT	Without ICT	With ICT	Without ICT
1	2	5	05,13	12,82	05,13	12,82
2	7	14	17,95	35,90	23,08	48,72
3	16	13	41,02	33,33	64,10	82,05
4	10	5	25,64	12,82	89,74	94,87
5	4	2	10,26	05,13	100	100
Total number of students	39	39				

The results of students taught without ICT and those with ICT were gathered and presented in the curve below (fig 17).The curve below represents the results of the two classes taught (without and with ICT).

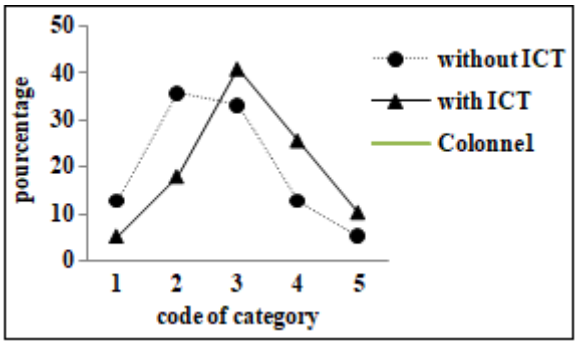

Figure 17: Results of the two classes taught without and with ICT (Digestion lesson)

According to the shape of the two curves, we can classify the results into three parts:

- The first part between category 1 and 3: very low and low marks up to average mark but not included.
- The second part: average marks.
- The third part: from category 3 not included up to category 5, that is to say, high and very high scores.

For the first part, we notice that the curve without ICT is lower than the curve with ICT, we can say that the use of ICT could reduce the percentage of students under the categories very low (7.69% of difference), and low scores (17.95% of difference). For the second part related to the average marks, we notice that there is a slight alteration (7.69% of difference) marked with an increase in the level of the class with ICT.

For the third part that corresponds to the categories of high and very high scores, we noticed that the curve of the class with ICT is higher than that of the class without ICT, this shows that there is an increase in the number of students under these categories; (12.82% of difference) in the category high score and (5.13%) in the category very high.

Depending on these results, we can note that by the use of ICT, the number of students who have low or very low marks has reduced, while the number of those who got the average, high and very high scores has increased.

3.3.3. Intestinal absorption

The following table represents results from the 3rd year middle school class who were taught the lesson of intestinal absorption with and without ICT.

Table 6: Representation of the results of the test

Code of the category	*Number*		Percentage		Cumulative percentage	
	With ICT	Without ICT	With ICT	Without ICT	With ICT	Without ICT
1	3	7	7.89	17.5	7.89	17.5
2	4	12	10.53	30	18.42	47.5
3	8	10	21.05	25	39.47	72.5
4	15	9	39.48	22.5	78.95	95
5	8	2	21.05	5	100	100
Total number of students	38	40				

These results which are obtained from tests with and without ICT have shown that the students taught without ICT have got bad marks, while the other group taught with ICT has got good marks. The curve below represents results of the two classes taught (without and with ICT).

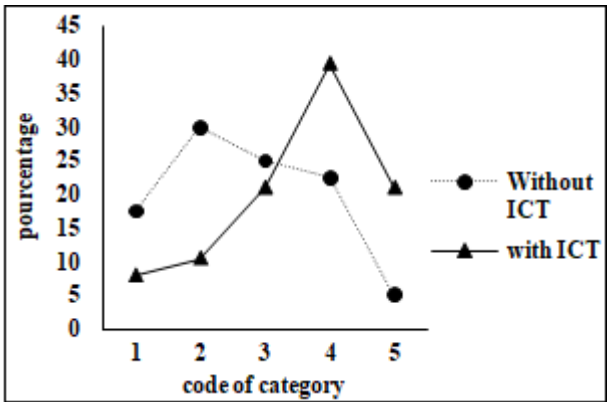

Figure 18: Results of the two classes taught without and with ICT (lesson of intestinal absorption)

According to the shape of the two curves, we can classify the results into three parts :

- The first part between category 1 and 3: very low and low marks up to average mark but not included.
- The second part: average marks.

- The third part: from category 3 not included up to category 5, that is to say, high and very high scores.

For the first part, we notice that the curve without ICT is higher than the curve with ICT, we can say that the use of ICT could reduce the percentage of students under the categories very low (9.81% of difference), and low scores (29.08% of difference).
For the second part related to the average marks, we notice that there is a slight alteration (3.95% of difference) marked with an increase in the level of the class without ICT.

For the third part that corresponds to the categories of high and very high scores, we noticed that the curve of the class with ICT is higher than that of the class without ICT, this shows that there is an increase in the number of students under these categories; (16.97% of difference) in the category high score and (16.05%) in the category very high.

These results confirm that the use of ICT has led to positive changes at the level of students' grades (decrease in the number of categories very low and low scores, and increase in the number of categories high and very high scores), this reflects the positive effort of ICT in understanding and assimilating the lesson of the human digestion for the third year middle school students.

4. Conslusion and Perspective

Some concepts of biology represent difficulties for students at the level of comprehension and assimilation; therefore, we have decided to conduct research which answers the following question: Does ICT contribute to promoting the students' comprehension, assimilation, and behavior?

The results of our research have shown that the integration of ICT in teaching the lessons of respiration, digestion, and absorption promotes the comprehension and assimilation of these lessons and improves the students' behavior during the session. However, there are questions that need to be answered today by the education and training sector. These questions are related to the introduction of this information and communication technology to the whole pedagogical field.

The lack of ICT in Moroccan middle schools puts the teachers in front of a big problem. Thus, all the decision-makers in our sector have to be aware of the necessity of these didactic tools in students' learning, especially when it comes to concepts that are difficult to assimilate and which need biological modeling which students already lack. Hence, this work could be handled from a different angle because it is restricted to precise concepts and levels.

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