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EFFECT OF A COMPUTERIZED NETWORK ON IMPLEMENTATION OF DIFFERENTIATED TEACHING AND LEARNING IMPROVEMENT IN PHYSICS

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Abstract- This work aims to study, the effect of experimenting with and evaluating a computerized system for teaching physics to a sample of high school students from the common core to the second year of the Baccalaureate (12 level) during 3 consecutive years. This choice was motivated by the interesting results of the 1st study carried out on 420 pupils in the common core, particularly those whose level was initially low [1]. This category of students benefited from the experiment when they moved up to the 1st year of the Baccalaureate and then to the 2nd year of the Scientific Baccalaureate. The students were divided into two groups, "a control group and an experimental group" in order to assess the system's impact. The lessons concerned mechanics and electricity. The device is based on the use of a computerized network as a tool for differentiated teaching, enabling groups of pupils to be formed according to their needs identified through formative assessment. The results show the importance of continuing this experiment in 1bac and 2bac to ensure that the drop in results observed in 41% of 1bac students and 6% of 2bac students among those who benefited from this experiment only in the common core. In the control group does not recur. This approach would help to consolidate the progress made and ensure greater academic success for students who have initial difficulties in physics.

Keywords: Physics, Mechanics, Electricity, Computerized Network, Device, High School Students, Differentiated Teaching, NetSupport School.

1. INTRODUCTION AND ISSUES

In recent years, ICTE has been increasingly used and exploited in teaching. Knowing how to use IT tools is proving essential, particularly for teachers, as a teaching aid, as an illustrator of concepts or even for conducting experiments [2]. They represent a set of technical, logistical and electronic resources whose purpose is not only to process information and communicate, but also to search, capture, store, display and transmit information using digitization, programming, automation and telecommunication processes.

Technology can provide teachers with the appropriate support to foster higher order thinking in students, a key element of 21st century skills for learners [3], In this case, technology is used as a pedagogical tool. whose value should be reflected in the level of student engagement and the nature of participation gathered [4]. ICTE can be used in a variety of ways in physics education, including simulations, data acquisition, animation and more. Educational software can be used to teach concepts or to observe or monitor the development of target skills in physics.

In one hand, Information and Communication Technologies (ICT) provide highly appropriate tools for providing greater flexibility both in the configuration of the learning space and in the management of group work. But, why is differentiation essential? Each learner is unique: they do not learn at the same speed or at the same time, they do not use the same study methods, they do not solve problems in the same way, they do not adopt the same behaviors, they do not have the same interests, and they are not motivated by the same objectives. In fact, there are several methods, including differentiated teaching, which seems to be a solution because it takes each child into account [5-9].

"ICT enables students to achieve success in a variety of activities and to differentiate classroom work structures by offering new learning situations; it also provides the classroom with a stimulating environment that evolves rapidly" [10].

In the other hand, learning by small groups of students is widely promoted as a pedagogical tool in many education systems [11]. However, despite research showing mixed results [12, 13], group work is still not widely used in classrooms [14, 15], and some teachers and students are not entirely convinced of its effectiveness [16-19].

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The American Cooperative learning movement [20, 21] proposes general principles to help teachers prepare their students to work in teams, thereby encouraging constructive interactions that promote learning at school [22, 23].

In view of the importance of ICT in the school context, particularly in the teaching of physics, we conducted a study [1]. The study aimed to conceptualize, assess, and appraise an ICT-infused system. This system was crafted to invigorate the teaching and learning of physics, optimizing the environment for differentiated instruction, and fostering learners' engagement in shaping their educational journey. The apparatus underwent in-person testing, pivoting around experimental undertakings and the integration of digital tools and resources to facilitate this endeavor, a computerized network was established utilizing NetSupport School software as an instructional aid. This software endows educators with an array of functionalities and opportunities encompassing assessment, oversight, collaborative work, remote control, and immediate utilization of quiz outcomes for diagnostic and formative purposes. These outcomes, in turn, drive the implementation of differentiated instruction.

The system underwent trials involving 420 learners from the shared core curriculum, the subjects of the experiment. Each of these learners was equipped with an individual computer or tablet and accompanying headphones. They were organized into groups of 5 or 6 individuals, with group composition adapting based on quiz outcomes. Both learners and teachers participated in the evaluation of the system's efficacy. The results were indeed captivating, as they demonstrated significant positive progress in enhancing learners' skills and behaviors. This was in stark contrast to the control groups that were not exposed to this approach. Given that, this positive evolution was more remarkable at the level of initially weak learners. In this study, we have tried to answer the following research question:

What is the effect of the above-mentioned scheme on this sample in the first and second years of the Baccalaureate? In Morocco, the secondary school is made up of 3 years of study: the common core, the 1st year of the Baccalaureate and the 2nd year of the Baccalaureate.

2. RESEARCH METHODOLOGY

The research was carried out in two stages:

The first stage was devoted to designing a computerized device for delivering first-year baccalaureate electricity and mechanics lessons to experimental groups. This included testing it and evaluating its effect on learning by comparing the test results between the experimental and control groups.

The second stage aimed to monitor the learning progress of a sample of learners who had benefited from the scheme during their first year of the baccalaureate in physical sciences and who went on to the second year of the baccalaureate. Test results were again compared between experimental and control groups. To do this, the computerized system was adapted to the 2nd year baccalaureate courses. The device was then tested and evaluated in the same way as before.

In every established classroom, students are grouped into 5 or 6 distinct clusters. Each cluster comprises 5 or 6 students, each equipped with their personal computer or tablet along with headphones. These small cohorts are adaptable based on differentiated teaching methodologies. Utilizing quizzes designed to identify cognitive and behavioral learning challenges, educators can promptly assess and utilize the results. Consequently, teachers can modify group compositions as needed. Each student also gains the opportunity for inter-peer dialogue within their cluster, fostering peer-based learning, as well as direct one-on-one interactions with the teacher. Students may also be encouraged to showcase their work to the entire class.

The assessment of the device's impact involved an initial analysis of the outcomes from ongoing evaluations among both the experimental and control groups. The control groups underwent the same learning process but without the computerized system. Continuous assessment tests and in-class assignments were utilized to gauge the extent of learners' progress. As a result, this approach was employed to measure the influence of the system on the cognitive advancement of the learners.

2.1. Study Sample

In the 1st year of the Baccalaureate, the study was devoted to four classes, each consisting of 30 to 32 learners. These learners all benefited from the computerized common core [1] and the results were very satisfactory. In fact, these learners, who were initially at a low level before the experiment, became average to good in mechanics and electricity. They were divided into two experimental groups and two control groups. the latter benefited from the courses without integration of the computerized system. The two control groups consisted of 62 learners and the two experimental groups of 60 learners. In the 2nd year of the study, and in view of organizational constraints, the sample that benefited from the experiment in the second year was halved. Thus, the group that benefited from the scheme in the 2nd year of the Baccalaureate was made up of 30 learners and the control group also of 30 learners.

2.2. Computerized System

In every classroom and for each session, a computer network has been established to create 5 to 6 groups of learners. This configuration makes it easier for teachers to manage the room and the group. To do this, we have opted for the integration of NetSupport School as an instructional tool, providing a diverse set of functionalities encompassing assessment, supervision, collaborative work, and remote control. Notably, NetSupport School serves the purpose of strategizing and delivering lesson content while also overseeing activities on students' workstations, thereby contributing to the sustenance of their focus and attentiveness.

NetSupport School was chosen for its ability to offer, among other features:

- Enable the teacher to share his or her screen with all or some of the students, in order to present paragraphs from the lesson, animations, videos, quizzes, etc. It would also be possible to broadcast a recording of the presentation, including its content (audio, video, files, etc.), on the students' computers, enabling them to view it later.
- Empower educators with the capability to observe, manage, track, and oversee student displays instantaneously from their personal computers. They can start or stop the connection, disconnect or reconnect students, and even disable the functionality of mice and keyboards across all devices within the classroom.
- Enable assessment of learning by allowing teachers to create instant surveys using predefined or personalized answers. The teacher can immediately obtain the answers from all the students as well as a class summary. They also possess the ability to share the survey outcomes with all students and dynamically form new groups in accordance with the assessment results.
- Ensure compatibility with the most widely used operating systems, including computers, tablets and even mobile versions for teaching assistants.

3. RESULTS AND DISCUSSION

For the rest, we note:

- TC: common scientific core
- 1bac: first year Baccalaureate
- 2bac: 2nd year Baccalaureate
- CT: Continuous test

3.1. Experimentation with the 1st Year Baccalaureate Students

The data presented in Figure 1 provides a breakdown of the results from the six sequential tests administered to the experimental group. These results reveal a noteworthy pattern; however, it's important to note that the trends observed in the 5th and 6th tests were less pronounced or significant. This can be explained by the fact that in the 1st year of the Baccalaureate, the exam is regional in nature and only covers literary subjects for the scientific students. These grades account for 25% of the final Baccalaureate grade, so learners focus on these subjects and neglect scientific subjects.

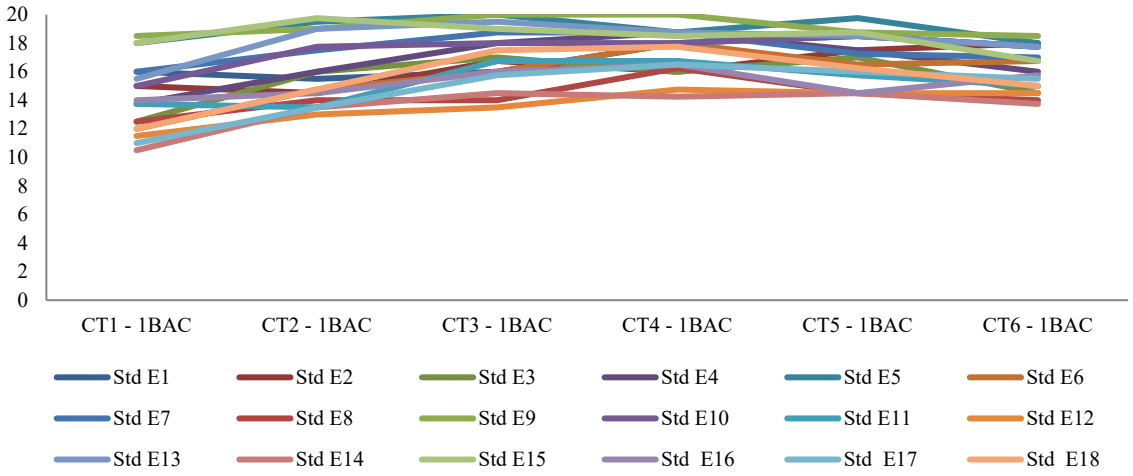

Figure 1. Test scores for 1bac students in the experimental group

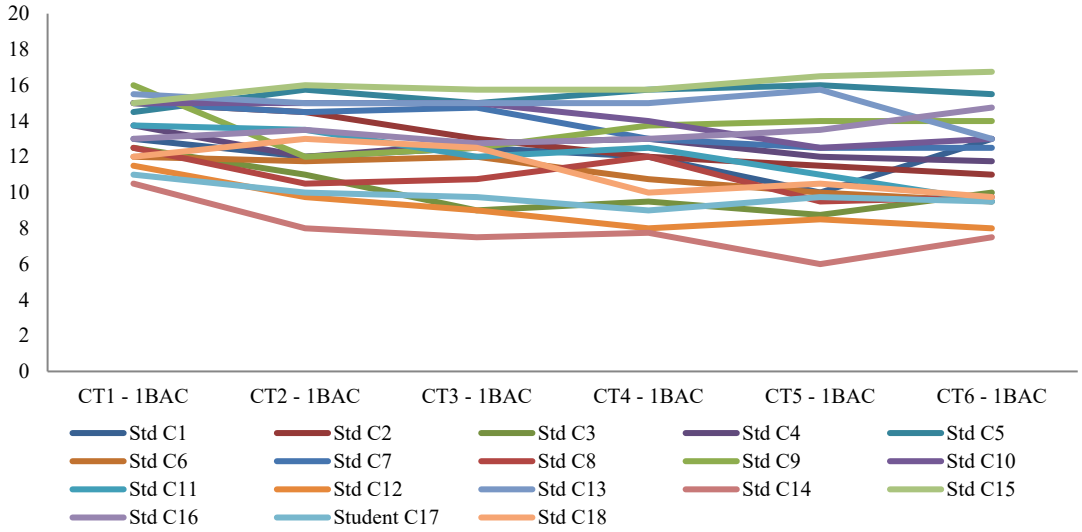

Figure 2. Test scores for 1bac students in the control group

a) Results of Experimental Group Evolution:

Compared with the results for the control group, there was some fluctuation.

b) Comparison with the Control Group:

- Increased workload: 1bac level generally requires a heavier workload than TC (the science syllabus is heavier than TC, plus the regional exam is based on literary subjects at the end of the year).
- Transition to a new environment (new classmates, new teachers and a new organization) and adapting to this new environment can take time.
- Autonomy and responsibility: in general, at secondary school (starting in TC but more required in 1bac), students are generally encouraged to take more autonomy in their learning. They are expected to manage their homework, study independently and be responsible for their own academic progress. Some students may find it difficult to adapt to this new responsibility and develop the necessary self-management skills.

Fluctuations in results are caused by a drop in level for 76.4% of pupils. In fact, 35% of students who initially had a good level in the common core fell to a low level, and 41% went from an average level to a low level, with only 23.6% retaining the level obtained at the end of the common core.

3.2. Experimentation with the 2nd Year Baccalaureate Students

In this section, we compare the results obtained from the controls in the experimental and the control groups.

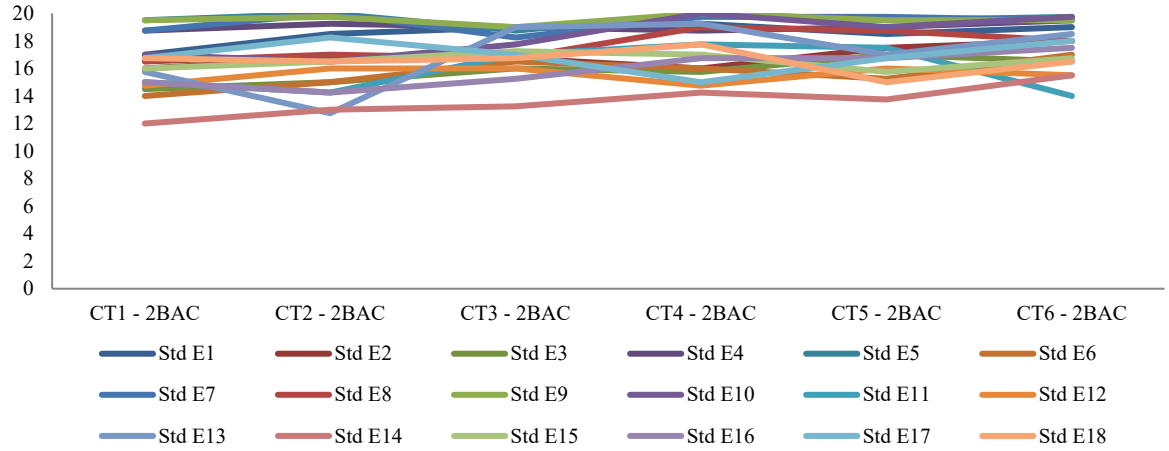

Figure 3. Test scores for 2bac students in the experimental group

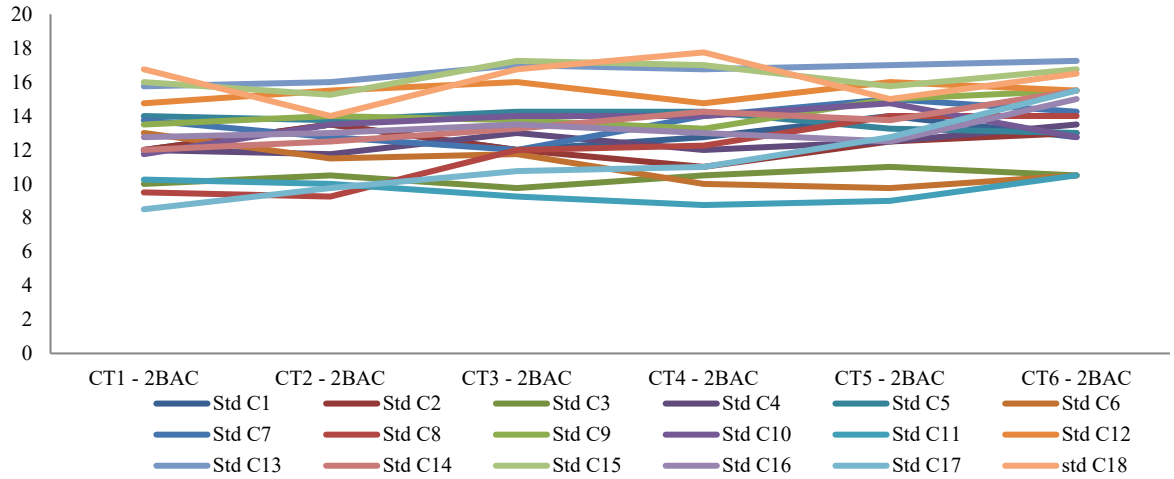

Figure 4. Test scores for 2bac students in the control group

a) Results of Changes in the Experimental Group:

In the experimental group, there was a change in marks, as shown in Figure 3, particularly for students with an average level initially. For the control group, as shown in Figure 4, results remained stable (almost the same mark) for 64.7% of the students, while 29% saw their level increase and 6% went from an average level to a low level.

b) Comparison with the Control Group:

These results can be explained by the fact that this 2nd year leads to the Baccalaureate diploma. This requires students to make a greater effort in science subjects in order to obtain their Baccalaureate.

3.3. From the Common Core (TC) to the 2nd Year of the Baccalaureate (2bac)

Within this paragraph, we now present the findings of a three-year investigation conducted by comparing the overall average of each continuous assessment in the common core up to the 2nd year Baccalaureate for:

- An experienced group in TC and also in 1bac and 2bac
- A group experienced only in TC
- A non-experienced control group

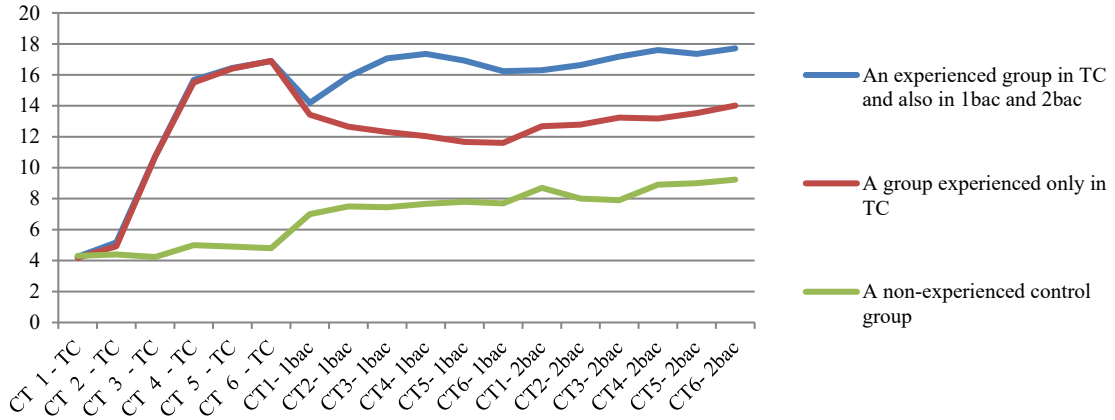

Figure 5. Changes in the average marks of students in each CT in TC, 1bac and 2bac

Students who initially had a low level in physics and benefited from a traditional course saw an improvement in their marks, although their cognitive level remained low in 1st year and also in 2nd year of the Baccalaureate. This was observed in 96% of the sample of 339 selected pupils. This situation can be explained by several factors. Firstly, the transition from college to secondary school can play an important role. In general, physics is often considered to be a secondary subject at college compared with secondary school, both in terms of the number of hours it is taught and the coefficient assigned to the subject in the assessment. Learners arrive in TC with gaps that are similarly difficult to make up in 1bac and 2bac. Essential notions and skills that should have been acquired previously may be lacking, making learning physics concepts at secondary school even more difficult.

For the groups who had only benefited from the common core, there was a considerable improvement in their cognitive level in TC, which rose from a low level to a good level. However, their level fell in the 1st and 2nd years of the Baccalaureate, which can be explained by the certification nature of this level. These results, compared with those of learners who had benefited from the experimentation of the computerized system during the 3 years of their study, show the positive effect of this experimentation. In fact, there has been a clear improvement in the level of the students, despite the fact that students in the 1st year of the Baccalaureate are more preoccupied with the literary exam, which accounts for 25% of the Baccalaureate mark.

4. CONCLUSION

The teaching of physics at secondary school has given rise to a great deal of concern, particularly with regard to students' misconceptions about learning mechanics and electricity. Overcrowded classes and a heavy timetable make the teachers' job even more difficult. In such a context, it is utopian to be able to manage the representations and learning difficulties of the majority of pupils and respond to their specific needs. This study delves into the implementation of an educational system tailored for teaching and comprehending physics, spanning from the fundamental core to the second year (12th level) of the Baccalaureate curriculum. This system is grounded in a combination of tutoring methodologies and information and communication technologies (ICT). The primary objective was to address challenges associated with implementing diverse teaching approaches within the specified context, along with fostering peer learning.

Moreover, the study sought to enhance the learning experience for all students, regardless of their proficiency levels, encompassing high-achievers, average learners, and those who face challenges in the subject. The results show that the use of differentiated teaching combined with networking can help to improve learning among pupils, including those with a low level of attainment. In fact, this approach has enabled new groups to be formed each time, according to the needs identified by the teacher, and the implementation of peer learning. As a result, the level of learners from TC to 2nd year Baccalaureate has improved considerably.

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