

Use of Computer-Assisted Experimentation (CAEx) in Teaching Science in Moroccan High Schools

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ABSTRACT: *Computer Assisted Experimentation (CAEx) allows real scientific experiments using a computer, composed of an electronic interface for data acquisition and sensor. The CAEx is a very important area for the use of ICT in experimental sciences. In Morocco, although the Ministry of National Education has equipped almost all high schools with equipment CAEx, studies have shown that CAEx remains little used in the teaching of physics and science and in high schools. Our study aims at identifying the obstacles that still hinder the use of CAEx in the teaching of physics and science in Moroccan high schools. For this, we opted for a survey methodology based on a quantitative-qualitative analysis of the responses retrieved following a specialized questionnaire. The overall results show that the integration of the CAEx encounters several obstacles despite the efforts made by the Minister of Education and Vocational Training.*

Keywords: Usage, Experimentation, Computer, Obstacle, CAEx

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1. Introduction

Computer-Assisted Experimentation (CAEx) refers to educational applications that use a computer system (computer, interface, sensors, and software) as a robot device (1). The CAEx is a very important area for the use of ICT in experimental sciences. computer-assisted experimentation allows to manipulate real objects. In an CAEx environment, the multiple sensors are connected to an electronic interface that communicates directly with a computer (2). This device offers the student the possibility to visualize in real time the scientific phenomenon in concomitance with its representation in multiple forms (3). The learner is thus able to create links between the multiple physical variables studied. The CAEx reduces the time spent on setting up the experimental setup; data acquisition and display (4).

It is also a transversal didactic tool since it can be applied in an identical way to several subjects (mechanics, electricity, etc.), but also to several fields (physics, biology, chemistry, technology, etc.). By releasing students from certain tasks such as data acquisition (5) suggests that learners have greater opportunities to employ a higher level of cognitive strategies in problem solving and conceptual development.

The objective of this present work is to study the use of the CAEx in science education, for this we asked the following questions: Are the qualifying high schools equipped with CAEx? What is the rate of use of the CAEx by teachers? And are there obstacles preventing teachers from using it?

2. Methodology

Participants

	The subject taught			
	PC		SVT	
	urban Effective	rural Effective	urban Effective	rural Effective
Man	104	22	40	18
Women	35	8	42	22

Table 1. Number of questionnaires distributed to teachers

To meet the objective of this research, we opted for a questionnaire survey. The choice of such an approach was based on the fact that this type of survey allows to interrogate a large number of secondary school teachers of physics and science. The sample is composed of 580 teachers of physics and science belonging to the Marrakech-safi Regional Academy of Education and Training, divided into qualifying secondary school teachers, belonging to the different groups. and practicing in rural and urban schools (Table 1). To carry out this survey and carry out our research, we made sure to distribute this questionnaire in coordination with the communication offices in the provincial directorates of the region. The biggest problem we encountered was the lack of respect for the retrieval of questionnaires for most teachers, which required us to make repeated visits to schools and to extend the duration of the survey. This field survey took us five months from January to May 2018. Out of 580 questionnaires distributed, 291 (or 50.17%) were returned.

3. Instrument

The development of the data collection questionnaire was based primarily on the results of our previous study conducted in qualifying secondary schools in Rhamna Province. It consists of a total of 17 questions (open questions, closed questions and multiple choice questions) divided into three parts. The first part presents the general information of the questioned, it is composed of questions concerning the identification of the author namely: the provincial direction, the commune (rural or urban), the taught subject, the age, the kind, and the training institution. The second part deals with the training on ICT and the use of the CAEx, The third part is composed of questions about the equipment in CAEx (type of sensors existing in the laboratories) and its use in the school. The last part tells us about the use frequency of the CAEx.

4. Data Analysis

The data collected were coded and prepared using the SPSS statistic 24 software. Thus, descriptive statistics of the different variables were carried out. Then, to test the influence of certain factors such as age, gender, some crosses were made.

5. Results and Discussion

5.1 Infrastructure and Training

The analysis of the data collected shows that 28% of the respondents have been trained on the use of the CAEx (Figure 1), and 70% of the responding teachers have not received any training on the use of this tool, despite the fact that 58.42% of schools are equipped with CAEx equipment (Figure 2), Note that 28% of teachers received training in the use of the CAEx of only four hours with the inspector of the subject concerned.

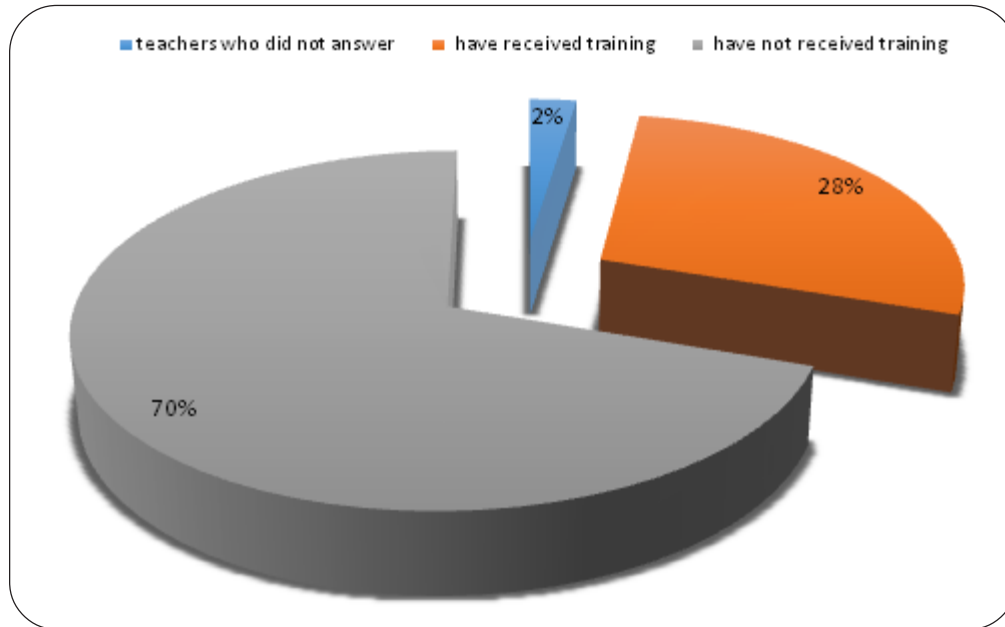


Figure 1. Percentage of teachers having received training on the use of the CAEx

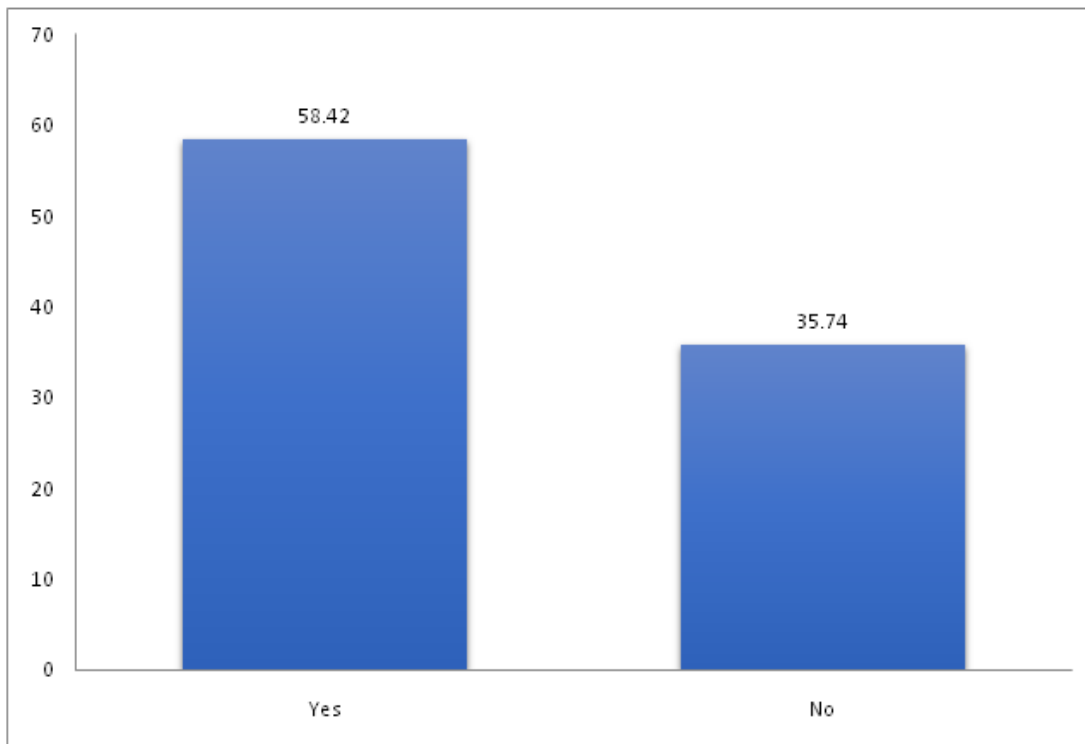


Figure 2. Percentage of schools that are equipped by the CAEx

5.2 Using the CAEx

The main results of this study show that (38.49%) of the respondents use the CAEx in class with their students, with a difference in frequency by each teacher (Figure 3).

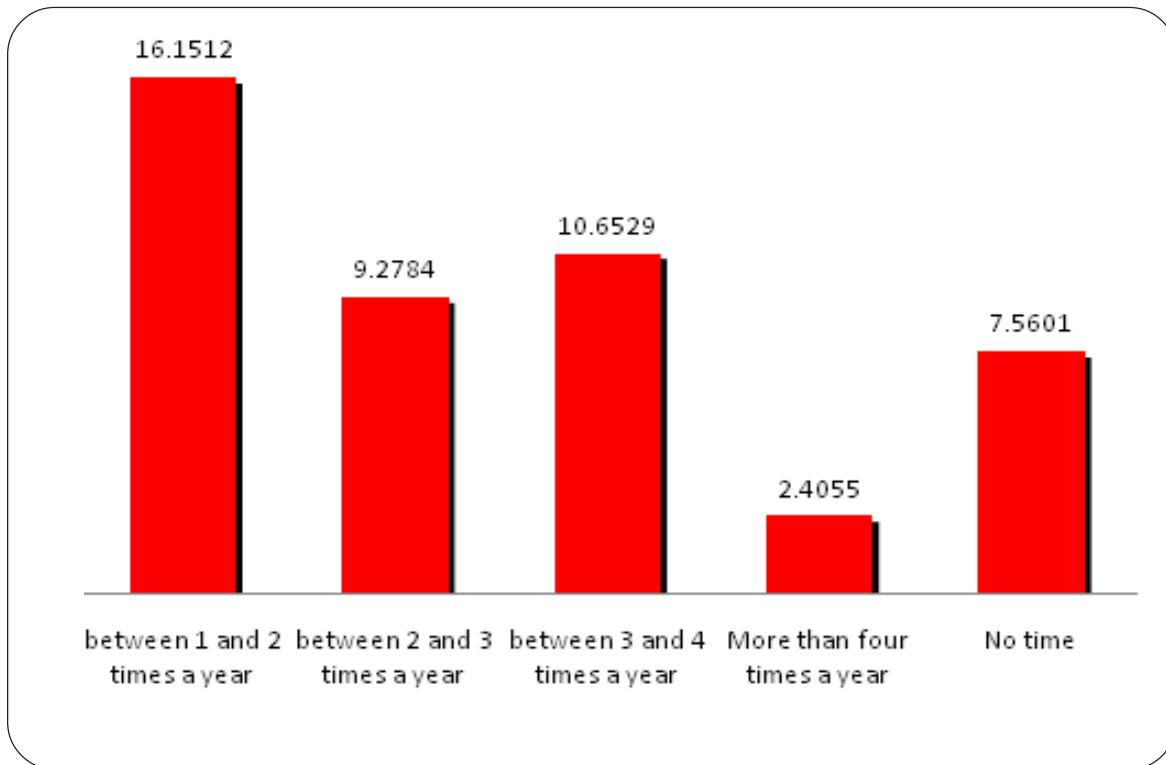


Figure 3. Percentage of the use of the CAEx in the classroom with the students

Reading (figure 3) shows that 16.15% of the participants use the CAEx once and twice a year, followed by 10.65% declaring to use this tool three to four times, and 9.28% use it between two and three times a year, only 7.56% of teachers never use it.

Crossover age with use of the CAEx by science teachers.

use of the CAEx	Age			
	between 22 and 30 years	between 30 and 40 years	between 40 and 50 years	more than 50 years
	12.72	12.72	8.13	13.43

Table 2. The use of the CAEx by teachers according to age

Reading this table makes it possible to highlight differences in the use of the CAEx among respondents according to their age. We find that 12.72% of teachers (between 22 and 40 years) of age, and 8.13% for those aged 40 to 50 and 13.43% for those over 50, use the CAEx in their school with their students. These results make it possible to affirm that the age factor does not influence the use of the CAEx.

5.3. Types of Sensors in Establishments

According to the statistical results given in Figure 4, 44.33% of the respondents say that their laboratory is equipped with the pH sensor, and almost 33.67% of the surveyed respondents say that their laboratory is equipped with the sensors. temperatures, pressures, voltages, conductivity and current. On the other hand, a small percentage of teachers say that their laboratories are equipped with sensors for CO₂, strength, distances, sound, O₂, teslamètre and 1.37% of respondents say that their laboratory does not contain sensors.

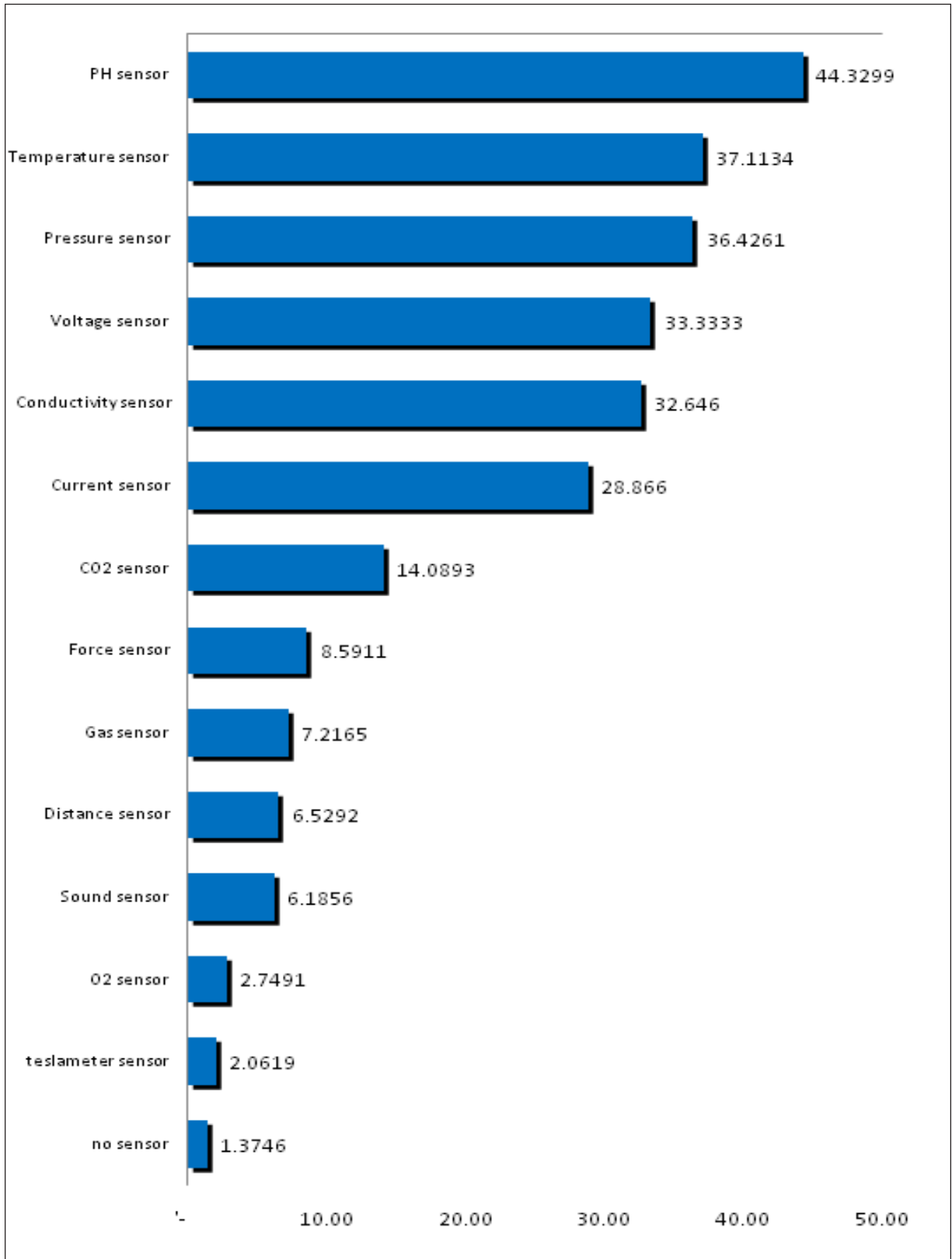


Figure 4. Percentage of sensor types by facility Obstacles to the use of the CAEx

	Agreed	Disagreement
The material is deteriorated	12.97%	87.03%
You do not have the necessary sensors	40.54%	59.46%
The equipment needs maintenance regularly.	25.95%	74.05%
Syllabus is overloaded and does not allow for experiments with students	40.22%	59.78%
The number of students in the classes is too high, which prevents the use of the CAEx.	70.68%	29.32%
I do not control its use	33.69%	66.31%

Table 2. Obstacle to the use of the CAEx

Table (2) shows that the respondents believe that the main obstacles to the integration of the CAEx into their teaching practices are related to the overworking of students in the classroom (70.68%), the lack of sensors needed in their classes. laboratory (40.54%), syllabus is overloaded and does not allow to perform experiments with students (40.22%), lack of training on the use of the CAEx (33.69%), that the equipment needs regular maintenance (25.95%) or that it is deteriorated (12.97%).

6. Conclusion

The study shows that almost 60% of establishments are equipped with CAEx equipment but the number and availability of this tool remain insufficient. Also, the types of sensors available in schools show that there is uneven distribution among schools. Added to this is the lack of continuous training of teachers, the number of students in classes is too high, the syllabus is overloaded that does not allow to carry out experiments with students due to lack of time.

To compensate for this unavailability factor of equipments in the institutions, it is proposed to supplement the Computer Assisted Experimentation (CAEx) with Computer Assisted Simulation (SAO). To achieve this goal, it is proposed to put more effort into two main components of the GENIE program: continuing training for teachers in CRMEFs and the production of digital resources.

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