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Towards The Integration of Computer Simulators in The Teaching of Physical Sciences in Drc: Case Of Ista / Kinshasa.

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ABSTRACT
In this work, we studied the possibility of improving the quality of teaching-learning of physical sciences (electricity and mechanics) that take place at ISTA/Kinshasa through the integration of computer simulators. For this, we based ourselves on the initial results of the research questionnaire that we distributed to all teachers of this subject in our host institution. We sought to understand their opinions on how the teaching-learning process of physical sciences is carried out in their institute. The analysis of the results of this questionnaire showed that the major problem that hinders the quality of the teaching-learning process of electricity and mechanics is the complexity of carrying out practical work with regard to the different physical phenomena. Moreover, this analysis has shown that it is possible to improve the quality of teaching-learning of electricity and mechanics at ISTA/Kinshasa by using computer simulators. This palliative solution to the absence of practical work in the teaching of physical sciences would compensate for the lack of equipment necessary for this training.

Keywords: ICT, technological innovation, computer simulators, ISTA/Kinshasa.

INTRODUCTION

Education is a good development tool for a country that seeks to build peace, eradicate poverty and promote sustainable development. In his time, Nelson Mandela, former President of the Republic of South Africa and former UNESCO Goodwill Ambassador said: "Education is the most powerful weapon we can use to change the world". Nowadays, the importance of education in our societies is no longer debatable, it has even become a necessity and a vital need just like the other needs in this category (breathing, drinking, eating, etc.). For the Organization for Economic Cooperation and Development (OECD), education contributes to wealth creation in the same way as political stability and a favorable macroeconomic context. This tacitly raises the question of improving the quality of the education system and training in our countries. Education is a human right for everyone throughout life. Also access to education goes hand in hand with quality (UNESCO, 2019).

According to the results produced by the Global Research report (2010), the DRC is not among the African nations that distinguish themselves in scientific research compared to South Africa (47,000 publications between 1999 and 2008), Egypt (30,000 publications), Nigeria (10,000 publications). For Muyembe-Tamfum (2013):

The current state of scientific research in our country challenges consciences. Among the causes of this dilapidation we note in particular: the small number of researchers in the various scientific fields, the lack of state funding, the dilapidated infrastructure in universities and research centers, the inexistence of teams and research themes (...)

The same author also affirms: "(...) in reality, the current educational system, whether in secondary schools or in universities, consists of brainwashing with countless abstract subjects; the student is not prepared to discover or innovate". The Congolese education system has difficulty meeting the employability needs of learners because the programs are generally focused on theoretical knowledge. This can be seen both in initial or primary training and in secondary or academic training. Indeed, the programs do not develop professional skills that allow for immediate employability (Hofnung, 2021).

All of the results of this survey have shown the level of dilapidation of the current education system in the DRC. Let us emphasize that since 1986 already Verhaegen (1978) had alerted on the tendency to the decay and the general destruction of the E.S. U (Ministry of Higher Education and University) in (M'BATIKA, 2015).

Faced with these deplorable results, solutions must be found. Among these, there is the arrival of ICT (simulators, sounds, images, animations, website or PowerPoint presentation) in education allowing the emergence of innovative means, not only for the dissemination of knowledge but also for the exploration of

learning strategies promoting the construction of competencies (Lebrun, 1999 and CSE, 2000) quoted by (Perreault, 2005).
Consequently, the current context must be taken into account beforehand in order to harmoniously integrate these pedagogical tools, since such an initiative brings about a real change within the school, which currently practices an outdated pedagogy. (Knoerr, 2005).
In order to contribute to the quality of teaching and learning, we try to study through the elaboration of pedagogical sheets and their experimentation; the impact and the effect of computer simulators on the acquisition of technical and analytical skills in students of ISTA/Kinshasa. Moreover, we encourage teachers to use in a general way, the computer tool and in particular, the simulators in their pedagogical acts. Let us specify that we are currently carrying out a prospective study on the net, with the aim of finding the best simulation software. This approach will allow us to propose pedagogical files that can be used by the teachers of this school in order to improve the technical and analytical skills of their students.
Finally, let us recall that the major problem identified in this research is the complexity of carrying out practical work in the teaching of different physical phenomena. To remedy the situation, we propose the integration of a techno-pedagogical approach based on the use of computer simulators.

ISSUES

The Democratic Republic of Congo is now the second largest country in Africa. With its sixty-seven million inhabitants and one of the highest demographic growth rates in the world. This country has a huge challenge to take up, such as the sustainable development of its territory for the general well-being of its population, more than half of which is under twenty years old. To achieve this we believe that education is the fundamental basis as well as higher and university education. (Maindo, 2012).
In this regard, the Congolese education system is in total chaos as a result of successive wars and especially because of the strong demographic growth, which has an impact on its capacity and quality (Enguta, 2020). According to a study conducted by Toengaho (2017), the massification of higher education has become a real problem that the DR Congo must correct to ensure the quality of education in its institutions.
According to figures published by the World Bank in 2012, out of 9,000 students graduating from Congolese universities each year, less than 100 students find work (World Bank, 2012). For Kanyinda (2018), who has worked on the difficulties of professional integration of ISTA/Kinshasa finalists, 61% of Bac + 5 graduates in technical fields have not found a job upon leaving university. According to the analysis of the results of his field survey, this problem of integration is caused by several factors, namely: "training that is not adapted to new technologies; the poor quality of the teacher's work, (...), the insufficiency of professional practices (...)" (p. 191).
This reality clearly demonstrates the need for training that must be linked to the African and international job market if we want our universities to truly participate in the country's economic growth. Faced with this painful situation, Congolese students are abandoning science and technological or applied training altogether in favor of SHS (Humanities and Social Sciences), which nevertheless offer very few job opportunities.
This observation is confirmed by the conclusions of our pre-survey conducted within this institution (study conducted between April-June 2021). Indeed, the results reveal that at ISTA/Kinshasa, 82% of teachers do not carry out practical work in mechanics and electricity with students. This is due to the lack of equipment in the laboratories, the massification of classrooms and the lack of computers available to students.
In addition, this survey reveals that all teachers do not use computer simulations to solve the thorny problem of the absence of practical work (TP). It should be remembered that practical work allows students to remain in the thick of their studies and to develop manual and practical skills that can be transferred to other fields.
These different problems, mentioned above, can lead to a dislike of technical studies among students. These different shortcomings have prompted us to reflect on the theme of : "the use of computer simulators or Information and Communication Technologies (ICT) in the teaching of physical sciences: case of ISTA /Kinshasa". On this, the central question of this research can be formulated as follows: In front of the absence of practical work noted in the ISTA/Kinshasa, which would be the advantages, as well for the teachers as for the students of this school, to use the ICT (the computer simulators) to palliate the absence of practical work in the teaching and the learning of physical sciences?

METHODOLOGY

During our pre-investigation carried out during the academic year 2020-2021 between March-May 2021 at ISTA/Kinshasa, we noted the absence of practical work in the teaching-learning of physical sciences particularly in the teaching of electricity and mechanics. Following this approach, we studied the possibility of improving the quality of this teaching by focusing on the means to put in place to circumvent the absence of practical work in the teaching of physical sciences. This is why we opted in this research for a methodological approach which is articulated around the following axes:

Documentary study

We conducted a documentary study based on the analysis of documents and the work of researchers who have previously addressed the issue of the poor quality of technical training provided to Congolese students attending technical schools, particularly those at ISTA/Kinshasa. The main consequence of this problem is that Congolese students find it difficult to be recruited in the labor market. Indeed, their training does not fit with new technologies and that it does not correspond to the expectations of employers (Kanyinda, 2018). Also, we have analyzed some documents that talk about the consequences of the poor quality of training on the painful employability situation of these students worldwide (World Bank, 2012).

This bitter observation pushed us to deepen our reflection first on the discovery of the different causes behind the inadequacies of this training. Then, we committed ourselves to looking for ways to contribute to its improvement. This personal approach explains the following brainstorming.

Brainstorming

We brainstormed with researchers, professors of physical sciences at the university level and also with former students of our host institution (ISTA/Kinshasa). We tried to shed enough light on the solutions to be put in place in order to improve the quality of teaching-learning of physical sciences in this school. This is precisely through the integration of a techno-pedagogical approach based on the use of computer simulators as a palliative to the problem of the lack of realization of practical works of physics (electricity and mechanics). During these interviews, we discussed the following points:

The percentage of practical work done by teachers with their students in the subject concerned;

The effective approach to be used to solve the problem of the complexity of carrying out practical work in the teaching of physical sciences (electricity and mechanics);

The use of simulations and animations to improve the quality of teaching-learning of physical sciences among teachers and students;

The identification of constraints that prevent teachers from using computer simulations in their teaching activities.

Questionnaire

On the basis of our fruitful exchange with the above-mentioned pedagogical actors and taking into account their relevant answers resulting from these interviews, we were led to carry out a questionnaire intended for the eleven teachers of physical sciences of ISTA/Kinshasa whose names appear in the table below:

Teacher's name	Academic title
MUDIAMPIMPA	Professor
KAHULI	Professor
TSHIZANGA	Professor
MPAKA	Professor
MBUYI	Heads of work
MPONG	Heads of work
MPENGE	Heads of work
MPIANA	Heads of work
MPANGU	Heads of work
KANGA	Heads of work
MBONGOMPASI	Heads of work

It should also be noted that the questionnaire included closed questions (with a Likert scale) on the teaching process and the use of simulations and animations in the physical sciences course. In the second part of the questionnaire, we formulated some open-ended questions (Simulation and animations during teaching) to allow the respondents to clearly develop their ideas on this use.

Data Collection and Processing

These questionnaires were distributed and completed by the teachers involved during the 2020-2021 academic year. The data collected were tabulated and processed using the SPSS "Statistical Package for the Social Sciences" software version 26.0.

RESULTS

1. The progress of the course session

Table 1

Question1: Do you have any difficulties in teaching this part of physics?	
Assertions	Results obtained in (%)
Yes	64%
No	36%
Question 2: As part of your physics teaching activities (mechanics and electricity), do you conduct the practical sessions with the students?	
Assertions	Results obtained in (%)
Yes	18%
No	82%
Question 2.1: If the answer is no, tell us a little more about the obstacles that hinder the realization of this Practical Work?	
Assertions	Results obtained in (%)
The institute does not have sufficient equipment	46%
The time allocated to the teaching of this subject is insufficient due to the overload of the program	64%
Classroom overcrowding	82%
The condition of the experimental equipment (defective)	36%
Question 2.3: If not, what is the percentage of completion of the Practical Work in question for the experimental concepts in this subject?	
Assertions	Results obtained in (%)
[0%-20%]	64%
[20%-40%]	36%
[40%-60%]	0%
[60%-80%]	0%
[80%-100%]	0%

2. The use of simulations and animations during teaching

Table 2

Question 3: To overcome this problem of practical work, teachers use computer simulators, are you one of them?	
Assertions	Results obtained in (%)
Yes	0%
No	100%
Question 4: What constraints would prevent you, for example, from not using computer simulators during your teaching activities?	
Assertions	Results obtained in (%)
Absence of computer equipment	90%
You do not master the computer tool	0%
You don't know how to integrate this tool into your teaching practices	10%
The software of the computer simulations	0%

cannot bring anything more	

DISCUSSION AND INTERPRETATION OF RESULTS

Following the compilation of the results obtained in our survey, we note that 64% of the teachers have difficulties in teaching physics. (These are respectively the mechanical and electrical parts). Given that the Institut Supérieur de Techniques Appliquées de Kinshasa is not well equipped both in terms of environment and teaching and learning. This reality may explain why several teachers encounter difficulties in their work. To justify this problem, our respondents put forward the following arguments: the absence of laboratory manipulations, the problem of teaching methodology, the insufficient number of hours and the problem of computer logistics.

Our results showed that the majority of teachers (82%) do not carry out the practical work sessions with the students. This handicap can be understood insofar as the respondents clearly state that:

- The institute does not have sufficient equipment (45%, i.e. 5 votes out of 11 respondents);
- The time allocated to the teaching of this subject is insufficient because of the overload of the program (64%, or 7 votes out of 11 respondents);
- Overcrowded classrooms (82%, or 9 votes out of 11 respondents);
- The condition of the experimental materials (36%, or 4 votes out of 11 respondents).

In this context, teachers opt for the multiplication of lectures and choose activities that they will carry out themselves instead of the recommended practical work. These results are consistent with the findings of studies conducted by (Houssaini et al, 2014; Chekour et al, 2016; Coquidé, 2000; Hassouni et al, 2014).

It is also noticed with some of the teachers' answers that the different practical works carried out by an infirm part of these respondents are: the use of bodies, electromagnetics, magnetism, pendulum motion, gravitational field, the most inclined motion, free fall of bodies.

The compiled results illustrate that the rate of carrying out practical work on a regular basis by the category of respondents concerned is between 0% and 20%. We think that this limitation of work potential could be due to the insufficiency of materials supposed to support this kind of activities, to the overloading of classrooms and to the lack of time allocated in the timetable for the teaching of the concerned subject (Question 2.1, table 1).

Our research shows that not all teachers use computer simulators to get around this problem of lack of practical work. This state of affairs, as we can see in Table 2 (question 3), is mainly justified by an infrastructural deficit (lack of computer equipment, absence of computer simulation software, outdated laboratory equipment, insufficient number of computers) and by the lack of teacher training in the area of technology and pedagogy. These results are consistent with those of (Karsenti, 2009, p.18).

CONCLUSIONS AND PERSPECTIVES

The present study conducted at ISTA/Kinshasa has allowed the Congolese state authorities to become aware of the defective facilities that hinder the quality of the dissemination of teaching to students at this institution.

The results compiled show that the learning environment offered to the students consulted is neither conducive to the type of learning concerned nor motivating for the learners.

To remedy this problem, we believe that it is more than opportune that the Congolese State, through its Ministry of Higher Education and University, re-examine the role that this academic institution is called to play in the construction of our country. A better training of engineers will ensure its success. Therefore, the ministry in charge should reflect on the conditions to better equip this institution. In order to promote learning, it is necessary to provide materials intended to enrich the expected learning (computer logic), to solve the problem of the massification of classrooms, to invest urgently in the continuous training of teachers on the practices of active pedagogy and on ICT.

Following our personal reflection concerning the lack of work in physics, the current results of our different researches conducted on this subject seem to show that the appropriate solution in this case could be the integration or the use of a real computer simulation software of the RIP type (Logiciels Reconnus d'Intérêt Pédagogique) ("Logiciels reconnus d'intérêt pédagogique", 2009) Since this tool will help teachers to meet the learning challenge in question by considerably reinforcing knowledge and significantly increasing students' motivation for physical sciences. These preliminary results merit further investigation.

That said, the future work we plan to do will focus on studying the impact of the integration and use of computer simulators in the teaching of physical sciences at ISTA/Kinshasa.

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