International Journal of Innovation Scientific Research and Review
Vol. 05, Issue, 10, pp.5253-5260, October 2023
Available online at http://www.journalijisr.com
SJIF Impact Factor 2023: 6.599

Research Article

ISSN: 2582-6131

TEACHING ALGORITHMIC AND CODING IN THE FIRST YEAR OF SCIENCE IN BUKAVU: AN EXPLORATORY STUDY

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Received 05th August 2023; Accepted 06th September 2023; Published online 25th October 2023

ABSTRACT

This study aims to assess the state of the art and identify improvement perspectives of the teaching of algorithmics and coding in first-year science at Bukavu, Democratic Republic of the Congo. In 2019, reforms were initiated to improve the quality of education, including the merger of the [Biologie-chimie and Maths-physique] sections into a single scientific section and the adoption of a new educational program. However, no study has yet been conducted to evaluate the applicability of this new program. This study is based on a questionnaire survey, direct observations in the classroom, and an analysis of students' notebooks during the 2022-2023 school year. The quantitative analysis of data collected from teachers from 33 schools offering the scientific section in the city of Bukavu, processed in SPSS, showed that teachers are qualified, and that the reform is applied by the majority of teachers in the city. However, there are still many challenges to be addressed [lack of textbooks, or popularization space, non-contextualization of teaching situations, ...] to perfect this introduction of elements of algorithmics and coding in the Congolese educational system. The originality of this study is to establish a state of the art of the teaching of algorithmics & coding and to identify improvement perspectives.

Keywords: Teaching, Scientific, Algorithmics, Algorithm, Bukavu.

INTRODUCTION

At the dawn of the new reform of the national educational program in the Democratic Republic of Congo, validated and generalized in 7th grade by Ministerial Order No. MINEPSP/CABMIN/1973/2018 of 26/06/2018 validating and generalizing the educational programs (EP) of the Science Learning Area (DAS) for the 7th grade class of basic education (EB), in grade 8th EB by Ministerial Order No. MINEPSP/CABMIN/599/2019 of 03/07/2019 validating and generalizing the DAS educational programs for the 8th grade EB class and in science section classes since 2019 by Order No. MINEPSP/CABMIN 600/2019 of 03/07/2019 setting up the single science humanities section; the study of the introduction of this new reform is not only relevant but also original, since it is part of the approach to finding solutions to the problems encountered by the majority of teachers in integrating ICT (Information and Communication Technologies) into their teaching practices, (Villeneuve, 2011, p. 50).

Indeed, although educational programs (EP) include a number of relevant elements such as matrices that describe well-structured frameworks for the competent handling of situations, (EPST3, 2021, p. 14) and these are supported by guidebooks (EPSP5, 2019, p. 2), there are still drafts that require careful study in order to be diversified and facilitate the teaching-learning process. Many teachers, whether qualified or not, face teaching difficulties due to a lack of support. Yet the UN (United Nations Organizations), in its Sustainable Development Goals (SDG 4.1) for the DRC, advocates quality education. If this is to be implemented, support measures are needed for those involved in education.

Indeed, the educational programs in place, as outlined below, are now focused on getting students active by dealing with situations that make sense to them and that call on essential knowledge to lead to the development of skills. According to the National Curriculum (2021, p. 14), learners entering the first year of science must have a basic understanding of algorithms: "Basic concepts of algorithms: Algorithm, program and language, Instructions, Variables and constants. Basic instructions: Input (read), Output (write), branching", EPSP5 (2019, p. 64); enabling him/her to solve certain elementary problems; and, on leaving this class, he/she should successfully and acceptably deal with situations that fall within the scope of algorithmics and coding; he/she should also use programming methods and tools as well as its techniques to solve everyday problems (EPSP5, 2019, p. 11). That said, the ICT teacher must contextualize the subjects learned in chemistry, physics and/or mathematics to show learners how to develop algorithms and implement them in a programming language in order to create programs in Python or C, capable of solving mathematical equations, for example. The Ministry of Primary, Secondary and Technical Education (PSTE) has undertaken reforms to improve the quality of teaching; these have been validated and generalized in all schools in the Republic, (EPST3, 2021, p. 5), since 2019 in the scientific section. However, to the best of our knowledge, no study has yet verified

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whether all schools in Bukavu are applying these reforms in full; bearing in mind that in 2010, for example, the failure to teach computer science in K-12 was due to unqualified teachers (CSTA, 2010).However, in the schools of Bukavu, during our observations during internship supervision, we noted that teachers have difficulty contextualizing these algorithmic notions, some don't even have the EP (Educational Program); others even confuse the method to be used (Situation based Approach) with the field in which the course to be taught [ICT] is located. All this makes the ICT course difficult for learners to learn, and a loss of earnings for them.

These observations provided the main motivation for this research into the teaching of algorithms and coding in DR Congo, in schools in the city of Bukavu. So, the main question of our research is: is the new reform of the SLD (Science Learning Domain) educational program being applied in its entirety to the teaching of algorithms and coding in the middle grades of the science section?

LITERATURE REVIEW

Teaching algorithms and coding in secondary education in the DRC

In secondary education, until 2003, there was no official computer science curriculum. However, some schools had already included computer science in their curricula (EPST7, 2007, p. 3). Computer science was officially integrated into the national secondary school curriculum in 2009, by Presidential Circular no. 436/PR of September 18, 2009.In this educational program, there are very few notions of algorithms and programming in 3rd and 4th year classes (all streams), with a few particularities in terms of number of hours (2 hours per week) for the Commercial and IT, Commercial and Administrative and Secretarial and IT classes, see appendix (EPST7, 2007, p. 27).

This 2007 educational program, which is still in use in the other options (Pedagogy, Social, Agronomy, etc.), teaches programming in Basic language except for Commercial & Administrative, Secretarial and Computer and Scientific; is largely outdated, and no longer meets the objectives of the present century, given the new technologies facing the scientific world.

So, in 2014, reforms took place in the Secretarial & IT (SI) sections, and resulted in the development of a new educational program in SI; in the options: Commercial and Administrative (CA) and Commercial and IT (CI); these reforms led to the merger of these 2 options to give birth to the Commercial and Management (CM) section with a new educational program, which, from start to finish (from 1st to 4th) of its curriculum, the learner only manipulates the tool for office automation purposes applied to accounting , finance, correspondence, ... to name but a few. The objectives pursued by the educational program (CM) do not enable learners to develop algorithmic thinking or programming. The program's objectives are as follows: 1st grade [use computer tools for elementary work],(EPST7, 2007, p. 25); 2nd grade [use computer tools to enter and prepare accounting and other documents], (EPSPT7, 2014, p. 51); Grade 3 [Use computer tools to enter documents and solve complex accounting and financial problems], (EPSPT7, 2014, p. 75) and Grade 4 [Use computer tools to enter documents and solve accounting and financial problems], (EPSPT7, 2014, p. 109).

Following the same logic as the previous educational program (that of CM), the Secretarial and IT educational program is IT applied to the management of office activities.

Since September 2016, (EPST4, 2021), other progressive curricular reforms have taken place, this time in the science section (the result of the merger of the Mathematics-Physics and Biochemistry options, see also (ARRETE N° MINEPSP/CABMIN 600/2019 du 03/07/2019), computer science is now called ICT [as in the 7th and 8th grade educational programs], a subject in the Physical Sciences and ICT subfield of the Science domain (EPST4, 2021); and, as a novelty, introduces algorithms and coding (programming) alongside Excel spreadsheet concepts, without specifying the environments in which algorithms are developed. Nevertheless, for coding (programming), it is recommended to implement them in Python languages as in France (Meyer and Modeste, 2022, p. 114) and/or in the C language (see Curriculum for the Science Learning Area: Sub-area of Physical Science and ICT in the Science Section) with the Notepad code editor. This new educational program is supported by a guide that clarifies certain notions; in other words, it constitutes a supplement to the program, (SERNAFOR1, 2018, p. 39).

Thus, each guide in support of the program contains the Code and title, essential knowledge, prerequisites, content details as well as pedagogical or didactic suggestions.

Teacher qualifications

As predisposed by National Education Framework Law n°14/004 of February 11, 2014 in Article 91, only the “Teacher Training Colleges” have the mission of training qualified secondary school teachers in all disciplines of general, technical, artistic and vocational education; organizing research in the field of applied pedagogy in order to improve the quality of nursery, primary, secondary and vocational education.

From article 91, we can deduce that only Teacher Training Colleges graduates in a given discipline are qualified to teach that discipline. For the purposes of this study, Teacher Training Colleges graduates, bachelors or bachelors of computer science are qualified to teach algorithms and coding at the middle level of the scientific section; bachelors or bachelors of computer science from other establishments must take an aggregation course.

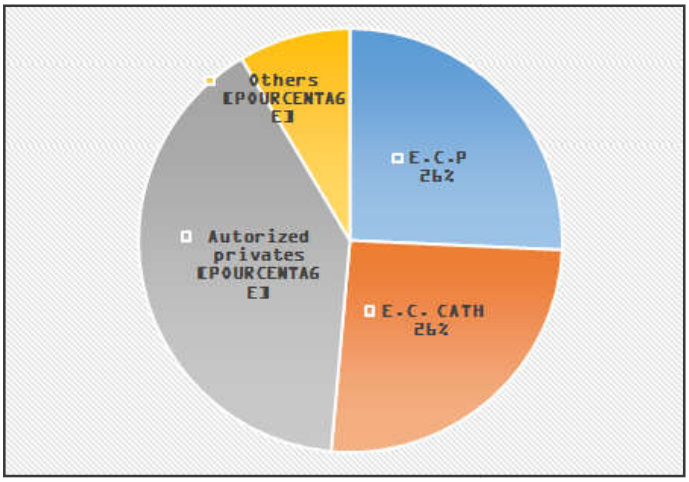
METHODOLOGY

Study environment and population

The city of Bukavu, capital of the Province of South Kivu, is located in the east of the DRC between 2°30'55" South latitude and 28°50'42" East longitude precisely in the basin called Eastern Valley Grabben (grand-lacs region), (Ngandu, 2014).According to the educational organization of the DRC, the city of Bukavu is located in the educational province Sud-Kivu 1, Ilundu (2019, p. 50); it (Educational Province for Promary, Secondary and Technical PSTE/Sud-Kivu 1) is piloted by the Provincial Direction, the main Provincial Inspection and the Provincial Direction of TPCS (Teacher Payroll Control Service).

According to the school geolocation report, South Kivu province has around 2175 secondary schools, EPST (2019, p. 12), including 396 (18.2%) in the city of Bukavu, DPST (2022).During our field visits, we officially identified 35 schools in the educational province of South Kivu 1, "ville de Bukavu", that organize the scientific section, EPST1 (2019, p. 14). Our sample consisted of 33 teachers in 4 educational systems: PS (Protestants schools), CAS (Catholic Schools, NAS (Non Agreement Schools, a term borrowed from CTPSE (2017)) and PS (Private School). They are distributed as follows:

Figure 1: Distribution of study population



Source: Bukavu I, II, III and IV educational sub-division reports.

Data collection and processing method

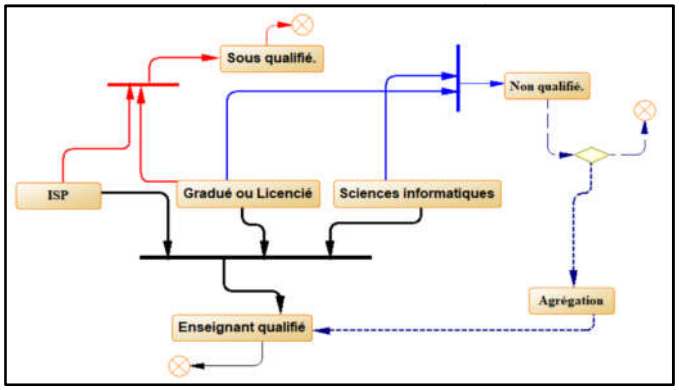
In this research, we used the quasi-experimental method supported by certain techniques. Our variables were measured by Pearson's Chi2 to identify or test the relationship of independence (ALPHONSE, 2016) and Spearman's Chi2 for qualitative variables, binary logistic regression to explain the causal link between our different variables, Cramer's V was useful to compare the intensity of the link between our studied variables. The documentary technique enabled us to delve into the legal texts (educational program, guide, ministerial decrees, National Education Framework Law, Constitution of the Republic, etc.) that govern education, as well as to consult virtual libraries on the Internet. The interview technique will also be useful for interviewing stakeholders: Teachers, Principal, Head master in the South Kivu 1 education sector.

Data collection was based on a survey questionnaire, direct observations and interviews with teachers. Using statistical analysis tools (Sphinx, Excel and SPSS), we analyzed and processed the data to produce summary reports, data graphs and pivot tables to help us interpret the results.

Processing the "Qualification" variable

This treatment stems from theories linked to teacher qualification (see Literature review section).

Figure 2: Variable qualification processing.



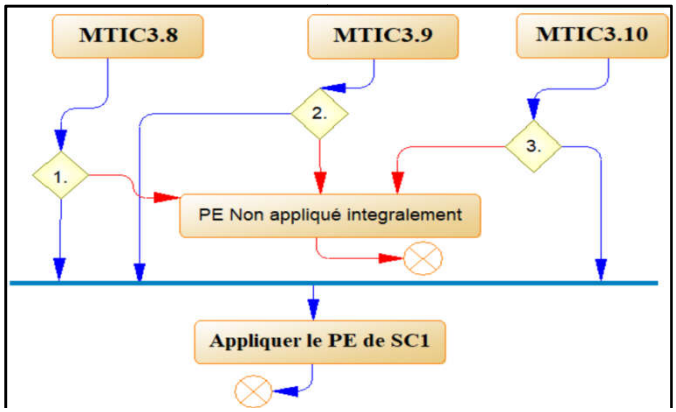
Source: Our own compilation, June 2023

At the end of the processing of these 4 variables (Last diploma obtained, finished in an ISP, Studied Computer Science and Agrégation), we obtain the variable "Qualified teacher" and code 1 if the teacher is qualified and 0 if he/she is not. The black arrow indicates a teacher who is qualified to teach algorithms and coding in Science, i.e. he/she has done Computer Science (Graduation/Licence) at a TTC; the red arrow simply means that this teacher has finished at a TTC but not in Computer Science (Under-qualified); the blue arrow means that the teacher has not finished at the TTC but has done Computer Science at another higher education institution, he/she is unqualified, so for him/her to be qualified as an "ICT teacher", he/she must pass the Agrégation.

Processing the variable Applying the SC1 educational program

The legislators have provided for 3 concepts in the first-year science curriculum, divided into 3 different [MTIC] matrices[1].

Figure 3: Processing the Apply SC1 educational program variable



Source: Our creation based on the educational program and program support guide for the Science Learning Area (SLA) in the first year of science; Learning Sub-Area: Physical Science Technology and ICT; Discipline: ICT.

From this model, we can see that the full application of the SC1 Algorithms and Coding Educational Program is the teaching of these 3 matrices as predisposed by the latter. Thus, teaching one or two matrices while omitting another is considered non-applicable.

The "Apply SC1 Educational Program" variable will be coded 1 if the program is applied and 0 otherwise. At the start of the first scientific year, students should be able to define the concepts of algorithm, instruction, operator, variable and input mask. MTIC3.8 means teaching the notions of conditional or alternative structures; MTIC3.9 simple repetitive structures and MTIC3.10 case structures.

RESULTS

Table 1: Socioeconomic and demographic characteristics of the sample.

Variables		Frequency	Percentage
Gender	**M**	**29**	**90.63%**
	F	3	9.38%
age range	Under 25	1	3.13%
	From 25 to 34 years old	19	59.38%
	From 35 to 44 years old	12	37.50%

[1] https://minepst.gouv.cd/programmes-scolaires/ , consulted this 09/30/2023

Last diploma	Licence	29	90.63%
	Graduate	3	9.38%
Trainerin aTTC	Yes	29	90.63%
	No	3	9.38%
Teacher Qualification	Yes	28	87.50%
	No	4	12.50%
Marital status	Bachelor	10	31.25%
	Married	21	65.63%
	Divorce	1	3.13%
Seniority	1-4 years	11	34.38%
	5-8 years	16	50.00%
	9-12 years old	1	3.13%
	Over 12 years old	4	12.50%
Be mechanized	Yes	10	31.25%
	No	22	68.75%
Management regime	Official School	3	9.375%
	ProtestantSchools	9	28.125%
	CatholicSchools	9	28.125%
	Private Schools	11	34.375%

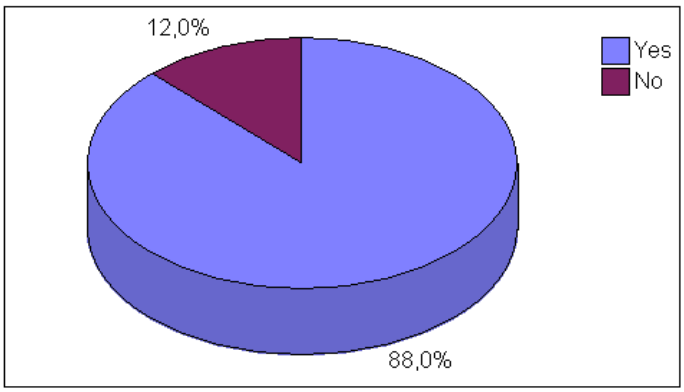
In terms of gender, men account for 90.6% of respondents, while women represent 9.3%. Only 3.12% of respondents are under 25; 59.38% are aged between 25 and 34. This means that the majority of teachers are still young; 37.5% of teachers are aged between 35 and 44.90.63% of teachers are graduates, compared with 9.3% who are undergraduates; 90.63% of them graduated from an TTC and 9.3% from other institutions.

After processing the qualification variable [see figure 2], we found that 87.5% of teachers were qualified and 12.5% unqualified.

31.25% of teachers are single, 65.63% are married and 3.1% are divorced. 34.38% of teachers have a seniority interval of 1 to 4 years, 50% have a seniority interval of 5 to 8 years, 3.13% have a seniority interval of 9 to 12 years and finally 12.5% have a seniority interval of 12 years or more.We surveyed 9.37% of teachers in official schools, 28.12% in Protestant schools, 28.12% in Catholic schools and 34.37% in private schools.

We found that only 31.25% of teachers were mechanized, while 68.75% were not.

Figure 1: Computer Laboratory

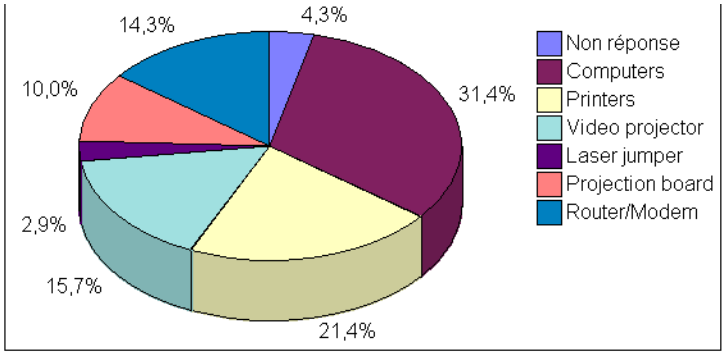


Source: Our results, July 2023

We found that the majority (88%) of schools have a computer lab, compared with 12% that don't. This is an important factor for the quality of teaching, given that the section itself is technical.

Laboratory equipment

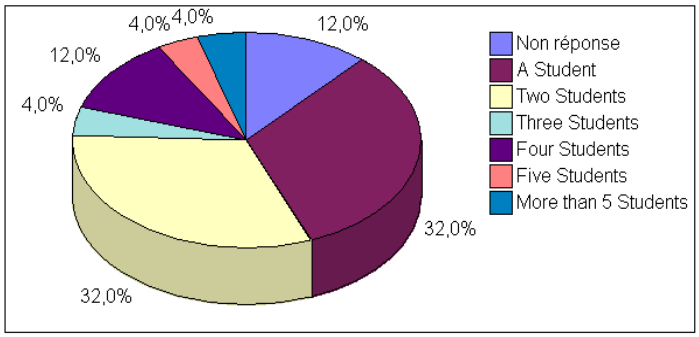
Figure 5: Laboratory equipment



Source: Our results, July 2023

Laboratory equipment is shown in this graph computers (31.4%) are the most widely used, followed by printers (21.4%), video projectors (15.7%), laser pointers (2.9%) are not widely used, very few schools use projection boards (10.0%), some schools use modems (14.3%). Non-responses (4.3%) may represent schools without laboratories.

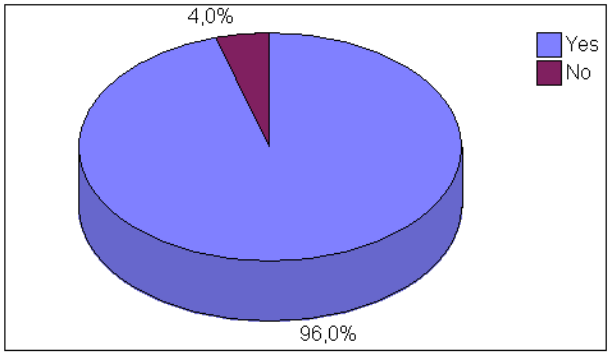
Figure 6: Average students per computer



Source: Our results, July 2023

Some schools are showing the will to equip their laboratories, nevertheless, many challenges remain, 32% of laboratories accommodate 1 student per computer, 32% others place an average of 2 students per computer, 4% of schools place 3 students per computer (), 12% of them place 4 students per computer and 4% of schools place 5 students per computer; other schools (12%) don't even have a setting (laboratory) where students can practice the concepts learned.

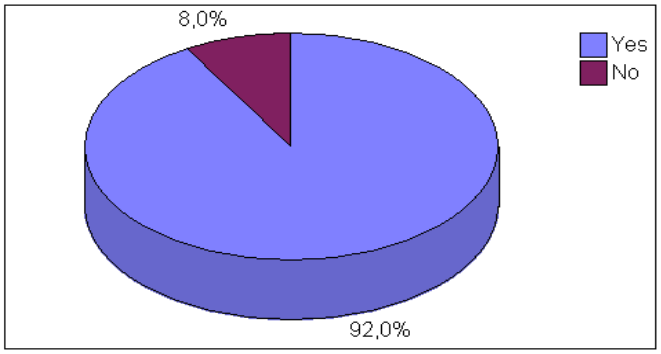
Figure 2: Knowledge of program renovation



Source: Our results, July 2023

4% of teachers are unaware that the program has been renovated, 96% of teachers know that the program has been renovated.

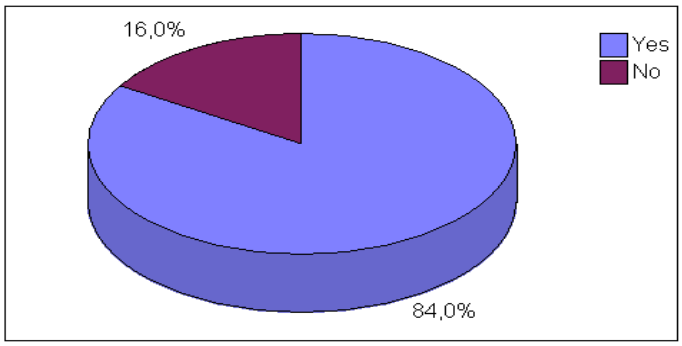
Figure 3: Possession of the first year scientific program



Source: Our results, July 2023

From these results we see that 8% of teachers (including some of those who know that the program has been renovated and those who are unaware that the Educational Program has been renovated) do not have the program while 92% of them do. possess.

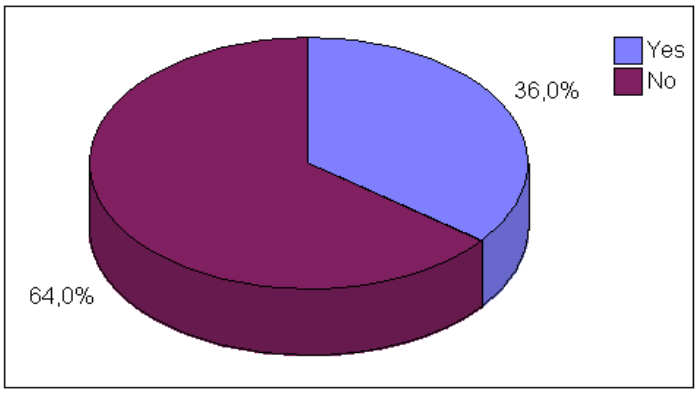
Figure 4: Possession of guide in support of the program



Source: Our results, July 2023

Having the program is good, but it is better to supplement it with the guide, since the latter provides more details on the subjects to be taught and dictates methodological directives to the teacher. 16% of teachers (including some of those who know that the program has been renovated, some who have the educational program and those who are unaware that the latter has been renovated) do not have the guide while 84% of them own it.

Figure 10 : Apply the SC1 Algorithmics and Coding Educational Program



Source: Our results, July 2023

This result shows that 36% of teachers fully apply the Educational Program, 64% of them do not apply it fully. This is a serious failure for the education of learners; in some schools, we found that teachers are not even aware that the educational program has been renovated even though it has existed since 2019; others only teach a few concepts and ignore the others and others, knowing well that the latter has been renovated, teach something else, even subjects which do not exist on the different educational programs.

Table 1: Synthetic table applied

Teacher-related variables		Yes %	No %	Pearson chi-square	Symmetrical measurement (Cramer's V)	Asymptotic significance (Bilateral)
Gender	M	37.9%	62.1%	0.025	0.028	0.088
	F	33.3%	66.7%			
Age	Under 25	0.0%	5.0%	0.692	0.147	0.707
	from 25 to 34 years old	58.3%	60.0%			
	from 35 to 44 years old	41.7%	35.0%			
Qualification	YES	39.3%	25.0%	0.305	0.098	0.581
	NO	60.7%	75.0%			
Marital status	Bachelor	25.0%	35.0%	1,097	0.185	0.578
	Married	75.0%	60.0%			
	Divorce	0.0%	5.0%			
Seniority	1-4 years	33.3%	35.0%	1,139	0.189	0.768
	5-8 years	58.3%	45.0%			
	9-12 years old	0.0%	5.0%			
	Over 12 years old	8.3%	15.0%			
Mechanization	YES	60.0%	36.4%	0.039	0.035	0.0844
	NO	40.0%	63.3%			
Management regime	EO	0.0%	15.0%	2,349	0.271	0.503
	ECP	25.0%	30.0%			
	ECCATH	33.3%	25.0%			
	EP	41.7%	30.0%			
Well-equipped laboratory	YES	46.7%	29.4%	1.012	0.178	0.314
	NO	53.3%	70.6%			
Follow APS training	YES	44.0%	14.3%	2.06	0.254	0.151
	NO	56.0%	85.7%			

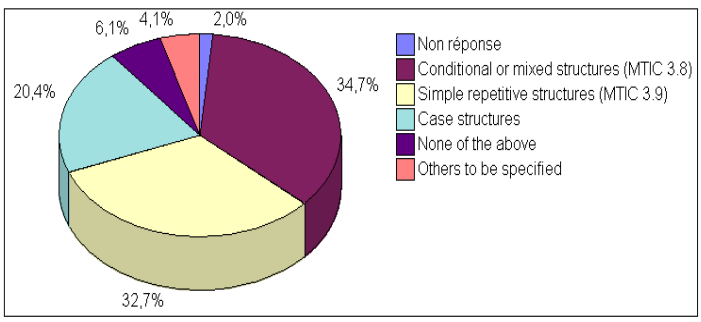
Source: Our results, July 2023

These results show that neither the fact of being a bachelor or a graduate, nor age, nor marital status, nor seniority, even less the management regime or division of the school, nor the fact of having a laboratory, nor the fact of having followed training in the situation-based approach explain in any way the application of the algorithmic and coding educational program in the first year of science; only 2 variables (gender and mechanization) have a significant impact on the application of the Algorithms and Coding curriculum in the first year of science, with 88% of the results predicting that gender would influence the application of the Algorithms and Coding curriculum in the first year of science, and mechanization would positively influence the application of the Algorithms and Coding curriculum in the first year of science. This may be due to the fact that those who are paid by the state feel motivated and those who are not paid feel demotivated. These results are 84.4% probable according to the binary linear regression test. And we can see from this table that 60% of those who are mechanized apply the Educational Program versus 40% of those who are not mechanized; 63.3% of those who don't apply it are not mechanized, and 36.4% are mechanized but don't apply it.Nevertheless, the table also shows that, in terms of age, 5% of teachers who don't apply the program are at least 25 years old, 60% are in the 25-34 age bracket, and 35% are in the 35% range; of those who apply the first science program, no teacher under 25 applies this program, 58.3% of teachers aged between 25 and 34 apply it, and 41.7% of those aged between 35 and 44 join their colleagues who apply it.

In terms of qualification, only 39.3% of teachers apply the program, while 60.7% of unqualified teachers do not. According to marital status, 25% of those who apply the program are single, while 75% are married. This can be explained by the fact that married people have an obligation to safeguard their jobs, given the multiple burdens placed on their shoulders. One might have thought that seniority would have a positive influence on the application of the educational program, but the tests applied showed otherwise. In fact, of those who apply the educational program, 33.3% with 1 to 4 years' experience apply it; 58.3% with 5 to 8 years' experience, and 8.3% with over 12 years' experience. In other words, experience would have no impact on the application of the educational program.

With regard to school management, the results of this table show that for those who apply the educational program, 25% are teachers from Protestant schools; 33.3% are from Catholic schools and 41.7% are teachers from private schools. As far as the computer lab is concerned, we found that 46.7% of teachers in schools with a computer lab apply the educational program, and despite the fact that their schools don't have a lab, teachers (53.3%) in some schools do their utmost to apply it. The results also show that 44% of those applying the program have taken the situation-based approach training, while 56% have not. Tests have shown that this variable has no impact on the applicability of the educational program in the first science class.

Figure 5: Concepts taught in SC1

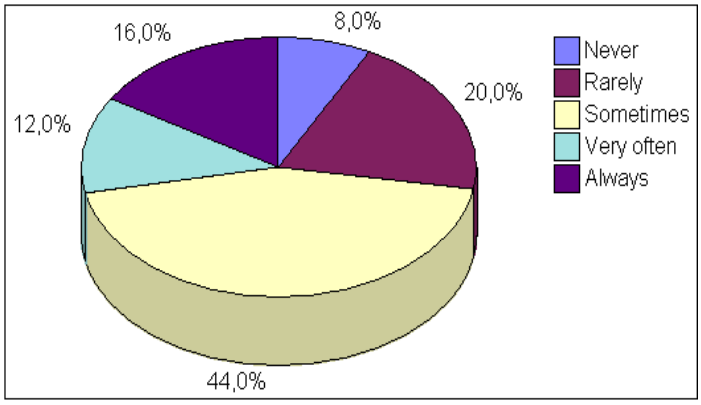


Source: Our results, July 2023

Conditional or alternative structures [see Information and Communication Technology Matrix (ICTM) 3.8] occupy first place (34.8%) among the concepts taught, followed by simple repetitive structures [ICTM 3.9] (32.7%); case structures (ICTM 3.10) occupy last place with 20.4%.These last 3 are the notions included in the first-year science algorithms curriculum; any other notion taught is outside the curriculum, as is the case for some teachers who taught none of these notions (6.1%) and others who taught other things (4.1%), and others answered nothing (2%).

Situation-based approach (SBA)

Figure 12: Use of the Situational Approach

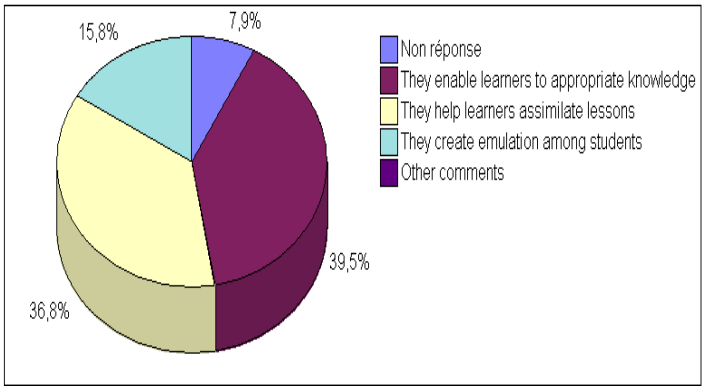


Source: Our results, July 2023

The methodological guideline proposed by the Ministry is to use the Situational Approach; these results show that 16% of teachers always use SBA in their teaching; 12% use it very often, 44% use it sometimes (not every day), 20% use it rarely and 8% never use it in their teaching, even though it is recommended by the Ministry.

Justification for choosing the APS method

Figure 13: Justification for choosing the APS method

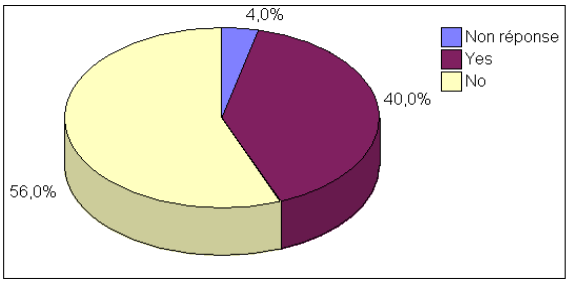


Source: Our results, July 2023

Some teachers (39.5%) claim to use SBA because it enables learners to appropriate knowledge; other teachers (36.8%) use it because it enables learners to assimilate lessons; others (15.8%) choose it because it creates emulation between learners and others (7.9%) remained neutral.

Problem of lack of materials

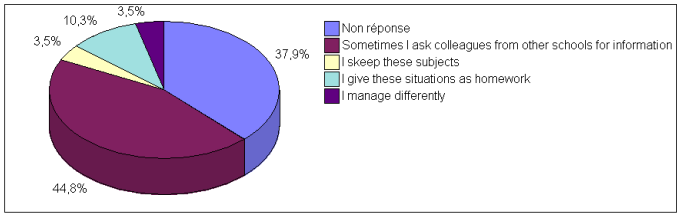
Figure 14: Lack of materials



Source: Our results, July 2023

56% of teachers said they had not missed any subjects, while 40% said they had missed teaching subjects.

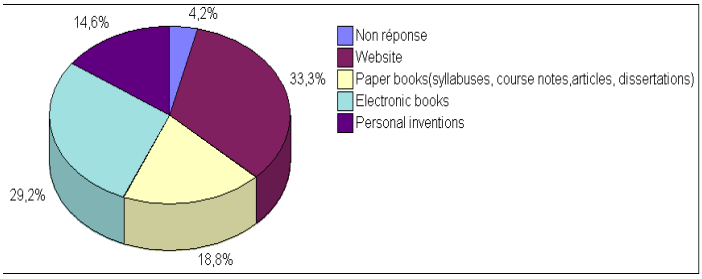
Figure 15: Teachers' behavior in the event of missing subjects.



Source: Our results, July 2023

37.9% of teachers remained neutral with regard to this questioning; however, 44.8% of teachers stated that they sought help from colleagues when they were short of subjects, 3.5% of teachers skipped subjects for which they were short of content, and 10.3% of teachers gave these subjects as homework to learners when they were short of what to teach.

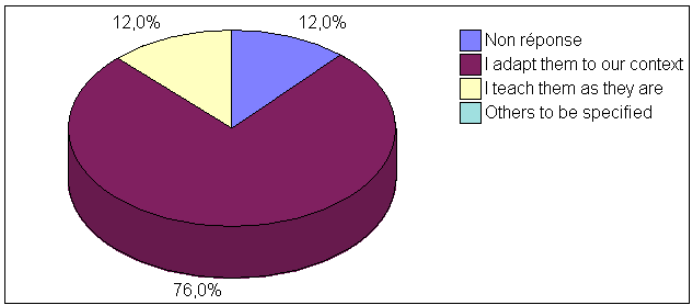
Figure 16: Teachers' reference sources



Source: Our results, July 2023

Although some teachers claim to be lacking in materials, they nevertheless draw on websites (33.3%), paper books (18.8%) or e-books (29.2%) in some cases, while others invent their own situations or materials, which is a serious threat to the development of the skills expected of learners.

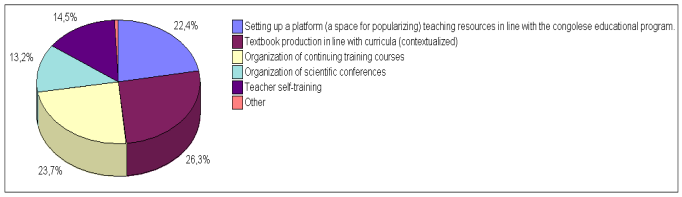
Figure 17: Teachers' attitudes to situations or materials found



Source: Our results, July 2023

Despite the fact that teachers refer to the Internet and other sources, there is still the problem of a lack of contextualization of content: 12% of teachers teach subjects as they have found them on the Internet or in books, others (76%) try to contextualize them in relation to the Congolese educational program, others (12%) have not given their opinion; in other words, they teach other things than what is set out in the educational program.

Possible solutions for teaching algorithms



Source: Our surveys, July 2023

Some teachers (22.4%) think that the establishment of a platform for popularizing educational concepts in accordance with the educational program would be a solution for the teaching of algorithms and coding; other teachers (26.3%) believe that the production of compliant (contextualized) textbooks would be a lasting solution; others (23.7%) offer continuing education; while others (13.2%) propose the organization of scientific conferences and some believe that self-training could be a solution to this problem.

DISCUSSION

The results of our field investigations provide an overview of the introduction of algorithmic elements into the Congolese educational program, which hardly existed in any section of secondary education. Renovated since 2018 (EPSP6, 2018) and popularized since 2019 by decree N° MINEPSP/CABMIN 600/2019 of 03/07/2019 establishing the unique section of scientific humanities, no study has verified whether teachers in DR Congo in general and those in the city of Bukavu in particular have appropriated this work (reform of the educational program). Our field surveys have shown that 87.50% of teachers are qualified, compared with 12.50% who are unqualified; a relatively low rate compared with the results found by EngutaMwenzi (2020); we believe that the introduction of this new educational program will be successful, since in 2009, in the USA, the failure to teach computer science in K-12 was due to the unqualified nature of the teachers (CSTA, 2010); however, according to our results, the teachers are qualified.

However, according to the tests [Chi2 and binary logistic regression statistics] applied predicted 84.4% (see Table 2) that the successful introduction of this new program is strongly linked to the empowerment (mechanization) of teachers. It may be that those who are paid by the government have a strong chance of applying the educational program, since they are motivated, and those who are not paid, feeling demotivated, don't have the bravery to apply the program.

Also, some schools (88%) have modernized in terms of infrastructure (see figure 5) and offer theoretical teaching supported by practical odes in the laboratory, although some schools place more than 4 students per computer, the average number of students per computer is 1 or 2 respectively with 32% according to our surveys. In the first year of science, the new program provides for 3 major concepts [see figure 10] that need to be contextualized (EPSP5, 2019; EPST3, 2021) in relation to concepts learned in other sub-fields of the science learning area; yet teachers teach certain concepts to the detriment of others, and those that are taught are not contextualized in relation to

the Congolese educational context (see figure 15 and 16), with teachers teaching them as they find them on the internet or in books. However, the non-contextualization of the educational program is a loss for learners, who find themselves outside the principle of focus. From the above, the Ministry plans to use the situation-based approach, yet only 16% of teachers (Figure 11) always use it in their teaching, while others (44%) use it and others (8%) never use it. We can deduce that there is a certain resistance to change on the part of some teachers who prefer not to innovate and encounter active methods, yet 88% of those who use the PSA affirm that it provides better performance, since it creates emulation and enables learners to assimilate knowledge.

Despite the fact that some teachers have embraced the new curriculum, some of them (40%) say they often miss subjects to teach, others (10.3%) send these subjects to the children as homework, and others (3.5%) even skip them. This remains a challenge to be taken up by educationalists, who are supposed to be proposing a course of action for this new educational program, rich in content but not backed up by accompanying measures to date, such as laboratory materials, textbooks and adequate pedagogical tools (software), as was the case in France by the **Grenoble Academy (Scratch) or in Madagascar by the ASI MGK** proposal by Ralahady (2022) , the educational partners that we are, we must interested in this approach to optimizing the quality of teaching as was done in France by Professor **Charly Piva** with the creation **of AlgoBlocs**(https://www.algoblocs.fr/index.php), or the IT site (https://elbahi.jimdofree.com/) of Professor **Mohamed Elbahi**in **Tunisia.**

Our surveys have shown that the first source of reference for teachers is the Internet, with 33.3% of teachers drawing material from it. A platform for popularizing algorithmic subjects could be a solution to this problem of lack of material, followed by the production of textbooks contextualized in relation to the Congolese educational program.

CONCLUSION

To sum up, the aim of this study was to take stock of the teaching of algorithms and coding in the first science class in the city of Bukavu. Although gradual, the introduction of algorithms into the Congolese education system is new and represents a significant advance that requires a contribution from the various educational players.

Although the authorities in some schools have shown a willingness to innovate and offer Congolese learners quality teaching, since ICT tools (Figure 5) are present in the majority of schools (88%) with qualified staff (87.50%), there are still many challenges [lack of textbooks, or popularization spaces, non-contextualization of teaching situations, non-mechanization of teachers, ...] to be met in order to perfect this introduction of algorithmic and coding elements in the science section. We therefore suggest that the government step up its efforts to mechanize teachers, and that teachers double their efforts to ensure that this reform is applied in full.

In future research, we intend to investigate the technical aspects used by teachers to develop and implement algorithms; and/or propose a platform for the exchange and popularization of algorithmic elements in line with (contextualized) the educational program in force in DR Congo.

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