Scientific Research Publishing

Open Journal of Social Sciences, 2024, 12, 251-264
https://www.scirp.org/journal/jss
ISSN Online: 2327-5960
ISSN Print: 2327-5952

Outlines of the Preparation and Integration of ICT Tools in the Educational Institutions in the Democratic Republic of Congo Context

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How to cite this paper: Binzaka, R. M., Okebukola, P. A., Shabani, J., & Byamungu, D. W. (2024). Outlines of the Preparation and Integration of ICT Tools in the Educational Institutions in the Democratic Republic of Congo Context. *Open Journal of Social Sciences, 12,* 251-264.
https://doi.org/10.4236/jss.2024.121016

Received: August 3, 2023
Accepted: January 22, 2024
Published: January 25, 2024

Abstract

The Covid-19 context has led to the closure of schools worldwide to stop the spread of the pandemic. This situation has disrupted not only school programs but also curricula. To face this challenge, distance learning has been a palliative adopted by several governments. This article attempts to investigate the level of preparedness of learners, teachers, and managers in educational institutions for this new didactic approach. To assess the level of preparation and integration, 423 subjects were selected at random from 47 institutions. The analyses revealed a very insufficient level of preparation of the respondents in all educational institutions. They also showed a very insignificant level of ICT integration. Thanks to the simple linear regression analysis, which showed a 51% prediction level of the level of ICT integration by the level of preparation, we noticed that the level of ICT integration reflects the preparation of the educational actors interviewed in the city of Goma.

Keywords

Level of Preparation, Level of Integration, Information and Communication Technologies, Educational Institutions, Democratic Republic of Congo

1. Introduction

The technological push of the twentieth century has left its mark on both educational and socio-economic institutions. Its influence can be seen in the technological achievements and the utopia generated by a great potential for change (Bertrand, 1998: p. 98).

The technological approach to education is not new and is still evolving. In the 1920s, the term instructional technology was already borrowed by an American unitary service to emphasize the development of educational tools (Charlier & Peraya, 2007: p. 32). It was seen as the savior of education in the 1960s. In 1968, the Americans set up the instructional technology commission, charged with analyzing the benefits of technology in education.

The word technology has a broad meaning and represents all the supports for action. It can also refer to the resources of tools, instruments, machines, processes, methods, routines, or programs resulting from the systematic application of scientific knowledge to solve practical problems (Bertrand, 1998: p. 98). Many ICT experiments have been conducted worldwide (Charlier & Peraya, 2007: p. 124).

Schools are becoming better equipped with ICT in developed countries, but this technology is still underused (Cleary, Akkari, & Corti, 2008). In Latin America, Costa Rica assumed a pioneering role in integrating technology into the education system already in the 1980s. However, integrating technology in teacher education is still a challenge (Christine, 2009).

In Algeria, research shows that ICT in education bridges the gap between machines representing the hardware side and learning pedagogy representing the side of educational practices and psycho-cognitive characteristics whose aim is to build a favorable learning environment. Moreover, research shows that there is also a lack of technological tools and high-speed internet in Algeria. In addition, there is a need to emphasize staff training in technology (Boutebal, 2020; Sabiraguha et al., 2023).

According to article 18 of the framework law governing education in the DRC since 2014, the national education system ensures education in information and communication technologies, taking into account the needs of society and ethical issues in order to meet present and future challenges in this field. To this end, the state promotes distance education, which is a technique implemented to provide distance training using information and communication technology devices.

What is known is that distance education is teaching offline (Nduwimana & Sindayigaya, 2023a, 2023b; Peraya, 1998; Sabiraguha et al., 2023). It means teaching through the mediation of communication media, since the teaching content, exercise, work instructions, etc., can only be transmitted to the learner through the intermediary of information and communication media: written documents, traditional or computerized audiovisual media, new communication, and information technologies.

Indeed, the challenges are both internal to the institution and external. ICT infrastructure in African institutions has several weaknesses: low bandwidth, lack of equipment, software, confidentiality, and computer data security (Bon, 2010). In addition, there are challenges related to high access costs, insufficient training of potential users (Thibeault, 2014), the pedagogical capacities of teachers (Okebukola, 2014) in the use and integration of ICT in teaching (Cleary, Akkari, & Corti, 2008).

Arbeit, Cros, Kasajima, Poumay, and Van de Poël (2010) have grouped the risk factors for ICT integration in education into institutional, technological, logistical, pedagogical, and supporting elements.

To reduce this digital divide, some African countries have been calling on international cooperation for the past two decades to benefit from collective Internet access points of digital public spaces (EPN) (Thibeault, 2014). In this perspective, it is worth mentioning: 1) the project for a computerised library and digital documentation centre at CEDESURK in synergy with the Kinshasa Francophone Digital Campus since 2002; 2) the "Backbone" project for the creation of a fibre optic network at the University of Kinshasa as well as a centralised IT service since 2003; 3) the "Désenclavement" project for networking (optical fibre and hertzian connections) of the University of Lubumbashi campus and the creation of the IT Resources Service since 2003, the "Eb@le" project for the creation of a Congolese digital network for research and teaching (NREN) connected to the African network Ubuntu Net since 2006; 4) the "UniversiTIC" program to open up the IT sector (connection, centralised IT service, website, e-learning, registration service and academic and financial management of students, technical training of IT specialists) for seven Congolese universities (UNIKIN, UNILU, UNIKIS, UCC, UCB, UPN, ISTA) and the University of Burundi (since 2008); 5) the European project "Eb@le-Santé" for the computerisation of medical records in hospitals linked to the universities of Kinshasa, Lubumbashi, Kisangani and Bukavu since 2009 (Rémon & Kasajima, s.d.).

These efforts include strengthening ICT in the curriculum at all levels of the education system. For example, in higher education institutions and secondary schools in the DRC, the computer course has a significant volume of time in all classes where it is not an option.

Indeed, while there are efforts on both sides, it should be mentioned that the Covid-19 context has further accentuated the use of ICTs in all sectors of life and particularly in educational institutions.

Indeed, one of the first measures taken to deal with the Covid-19 pandemic and stop its spread was the containment of the population. In this phase, schools were closed at various locations (Okebukola et al., 2020), forcing children, young people, and teachers at all levels of the education system to stay at home. This has led not only to the disruption of school calendars resulting in longer school years (Okebukola et al., 2020) but also to subjecting learners to an unusual pace of teaching and learning. Indeed, unsure of when the threat of COVID-19 would be removed, schools were encouraged to engage their students in a virtual form of curriculum delivery (Okebukola et al., 2020).

In ICTs have played a controversial role in saving the education system in this context; digital technology is an effective and efficient lever for dealing with some of the difficulties natural disasters such as floods, fires, and pandemics can create (Abdou & Abdoul, 2020).

The rescue of ICT in education in the Covid context is seen through the growth of online courses on MOODLE teaching platforms, courses on Zoom

videoconference, radio and television lessons, etc.

Research (Arbeit et al., 2010) notes that the teacher is a crucial key to the pedagogical exploitation of ICT. For the same report, this often requires changes on the part of the teacher that need adequate pedagogical support. Charlier and Peraya (2007: p. 71) state that the learn-net project aims to provide teachers with an authentic and demanding learning experience that leads them to fully mobilize themselves to appropriate no cognitive content and skills for collaboration and manipulation of technologies. They invite them to a particular form of displacement to learn differently at a distance with new means in a group and with the group's help.

However, it is essential to recognize that the teaching profession is in crisis about the reforms implemented by the authorities on the integration of computer science teaching, which is disrupting the school in its internal organization, the practice of transmission of knowledge. Let us mention with the research that before Covid, several African countries were lagging in integrating ICT due to several challenges (Bon, 2010; Arbeit et al., 2010; Okebukola, 2014; Okebukola et al., 2020). The DRC was not left behind.

In DRC, precisely in the provincial city of Kinshasa in Ngaliema, research shows that the level of integration of ICTs is still low in the institutions. The skills assessed are still at the level of office work and word processing. The internet is only used for social networking. The absence of these new means of technology acquisition, the lack of internet and motivation, and the lack of adequate training are the leading causes (Kapinga et al., 2018).

So how are educational institutions integrating ICT into teaching in the DRC in the middle of the Covid period? At what level have teachers and students been prepared for using ICT? What has been the level of ICT integration in educational institutions in the DRC? What are the risk factors in the preparation and integration of ICT in education?

In the ICT literature, two trends have developed. These are the systemic and multi-media trends.

The concept of a system strives to link together rather than isolate, relies on global perception rather than detailed analysis, considers interactions rather than elements, insists on the study of transactions that take place at the interface points between the system and the environment, and gives us a vision focused on the dynamic and interactive aspects of the sets that make up reality (Lapointe, 1993; Bertrand, 1998). Within this framework, the theory of instructional design invites the teacher to identify the objectives, collect data on the characteristics of the students, which leads them to adjust the objectives accordingly; analyze the teaching resources at their disposal and the constraints they will have to face; build an operational teaching and learning system; and finally, provide mechanisms for evaluating the learning results, which allows them to modify the organization of the system (Bertrand, 1998).

For the same author, the multimedia approach consists of examining the technological environment from the city and building increasingly interactive

systems. In this perspective, the course evokes mediatization and mediation. According to Peraya (2006), when we mediate a content, we express it in the characteristic language of a given medium. At its origins, the notion of mediatization makes us think of the use of the post office, the telephone (Peraya, 1998), radio, and the evolution of ICT has enriched television (Peraya, 2000) and (websites, videoconferencing). Pedagogical media are then forms of mediated educational communication, particular systems of representation, or even semi-cognitive systems organized in a genre of text and specific types of discourse (Peraya, 2000: p. 19), embedded in a pedagogical device. According to Peraya (2000: p. 22), the latter remains an organization of means at the service of a strategy, a finalized, planned action to obtain a result (Peraya, 2000).

In the teaching-learning process, Russell et al. (2003), cited by Cleary, Akkari, and Corti (2008) distinguished:

1) teacher's use of ICT for lesson preparation;

2) teacher's use for presentation,

3) teacher-guided student use;

4) teacher's use for special education and differentiated instruction;

5) teacher's use for email; and

6) teacher's use for assessment of student work.

Furthermore, more researches distinguish between low-level and high-level ICT use (Ndayisenga et al., 2024; Nduwimana & Sindayigaya, 2023b; Sabiraguha et al., 2023; Tintiangco-Cubales et al., 2015). The former refers to typing/report writing and internet research, while the latter refers to multimedia presentation, database analysis, or collection and interpretation of original data (Cleary et al., 2008).

About the integration of ICTs, a distinction should be made with UNESCO:

1) the emergence phase characterized by the acquisition of technologies and where teaching remains teacher-centered;

2) the application phase where ICT is increasingly used but as a supplement where ICT is taught as a separate subject;

3) the penetration where teaching uses a wide variety of resources and is primarily student-centered and

4) the transformation where ICT is fully integrated into classrooms and becomes an everyday reality of the school (Cleary et al., 2008).

Fitzallen reminded us that teaching is a profession that requires high professional qualifications to which the skills of using ICT and integrating it into teaching must be added (Fitzallen, 2004). For Coen (2007: p. 125), neither the availability of materials nor the demonstration of their educational effectiveness is sufficient to generate their use in the classroom. Hence, the thorny issue of teacher preparation. In this process, three levels can be distinguished, namely:

1) adoption, where the decision is made to change something in one's practice;

2) implementation where changes in practice and environment are noticeable and

3) routinization, where the new practices are integrated and mastered (Cleary

et al., 2008).

After a decade of pilot projects, Arbeit et al. (2010) highlighted the gradualist approach in integrating ICT in schools. According to these authors, it includes components related to teacher training, the development of digital resources, the provision of ICT to the community, student learning, and the management of the school's education system. These components can be integrated into several possible scenarios.

A study conducted in Morocco was done on the conditions of distance education during the confinement due to COVID-19, the following difficulties were found: students are not familiar with ICT in teaching, students do not always have the means to acquire a smartphone, a tablet, a computer or an internet connection, students are bombarded by the burden of assignments and digital resources, some teachers have not been sufficiently engaged or who do not regularly integrate ICT in their teaching-learning practices (Hantam, 2020: p. 15).

2. Methods and Methodology

To answer the questions posed in the introduction, we conducted a survey in primary, secondary, and higher education institutions in the city of Goma among teachers, pupils, and students. The two-stage random sample was conducted. The description of the sample is given in the following table.

2.1. Respondents' Description

Out of a total of 441 respondents, it was found that the respondents had different functions, starting with students, primary and secondary school teachers, university teachers, administrative staff, and those with both teaching and administrative functions. More than half of the subjects were male. Their educational levels range from secondary 5 to doctorate. The institutions of the respondents are mainly located in the commune of Goma. The number of educational institutions surveyed amounted to 47, all with different levels of education as present in **Table 1**.

2.2. Data Collection Process

We developed a questionnaire with 36 closed-ended items for data collection, 6 of which were dedicated to identifying the respondent, 15 to ICT readiness, and 15 to integrating ICT in teaching. The ICT readiness and integration questions have responses on a Likert scale. The data collection covered two months, December 2020 and January 2021. Fifty students from the Faculty of Psychology and Educational Sciences of the *Université Libre des Pays des Grands Lacs* were recruited as interviewers. Kobo Collect facilitated the administration of the tool. The interviewers were trained for two days and deployed to test in the non-drawn institutions for one day. After testing, three items were trimmed from the questionnaire due to the redundancy of information provided by other items. Each interviewer was equipped with a tablet that facilitated this work. The

Table 1. Description of the sample.

Variables	Code	Value label	N
Function	1.00	High school student	9
	2.00	Elementary school teacher	155
	3.00	High school teacher	105
	4.00	University teacher	12
	5.00	Teacher with an administrative function	35
	6.00	Student	83
	7.00	Administrative staff	42
Sex of respondent	1.00	Male	264
	2.00	Female	177
Level of education	1	5th Secondary	5
	2	Secondary 6	92
	3	second degree	22
	4	Second license	125
	5	Doctor	4
	6	Master 1	2
	7	Master 2	4
	8	First degree	24
	9	First license	38
	10	Third-degree	115
	11	License	10
Localization of the institution	1	Commune of Goma	280
	2	Commune of Karisimbi	161

administration of the questionnaire was direct and indirect. Subjects familiar with the tool were given the tablet to fill in the answers themselves, while for the others, the interviewer checked the answer on the tablet after reading the question to them.

For the purpose of the analysis, it should be mentioned that the levels are rated as follows: none = 1; very inadequate = 2; inadequate = 3; adequate = 4; very adequate = 5. The total scores range from 15 to 75 for ICT readiness and ICT integration, respectively.

2.3. Data Analysis

Thus, we resorted to descriptive and inferential statistics for the data analysis. Through the latter, the study of multiple and simple linear regressions made it possible to bring out the level of prediction between the dependent variables, which are the location of the institution, the training cycle, the gender, the func-

tion, the institution, and the dependent variables, which are the level of preparation and the integration of ICTs; on the other hand, to analyze the link between the level of preparation and the level of integration of ICTs. All analyses were performed using IBM SPSS software22.

3. Presentation of Results

The results are divided into three sections. The first section presents the responses related to the first question, i.e., the respondents' level of preparation for ICT. In contrast, the second section presents the results related to the level of integration of ICT into the curriculum, thus answering the second question. The third section crosses the independent variables with the dependent variables and thus answers the third question posed in the introduction. Overall, the Cronbach alpha coefficient shows a reliability of 0.966.

3.1. Respondents' Level of ICT Readiness

As shown in Table 2, it appears that teachers have an insufficient level of computer skills. They have not been made sufficiently aware of the use of ICT to integrate them into their teaching.

The training received for the integration of ICT in teaching also remains insufficient. The training received was very insufficient in the use of ICT for the benefit of teaching evaluations, the use of PowerPoint software, the creation of a video, the use of ICT in lessons, the use of the video projector, registration to an

Table 2. Respondent preparation's on ICT use.

Question	N	Mean	SD
Computer Science	441	3.20	1.03
Use of ICT in education	441	3.08	1.12
Use of ICT in teaching	441	2.71	1.23
Use of ICT tools for assessment	441	2.33	1.31
Use of PPtx	441	2.23	1.29
ICT tools for preparing lessons	441	2.20	1.31
Creation of a video for teachings	441	2.19	1.28
Use of ICT in lessons	441	2.19	1.30
Video projector	441	2.14	1.32
Registering process for an online course	441	2.00	1.21
How to log in, register or join online learning activities	441	1.99	1.24
Creation of a website	441	1.90	1.19
Activities on a teaching platform	441	1.89	1.17
Use of online software for interaction	441	1.88	1.16
Creation of an account for distance learning	441	1.00	5.00

online course, the creation of a teaching site, the holding of activities on a teaching platform, the use of online pedagogical interaction software, the creation of a Zoom or Web team account, Skype, to organize distance learning.

3.2. Level of Integration of ICT in Teaching

As presented in Table 3, the computer course theory and practices are insufficiently integrated into the educational institutions. The use of ICT in teaching remains very insufficient, i.e., the use of Moodle, video conferencing, social networks, evaluation, preparation, video projectors, PPtx software, pedagogical interaction software, the holding of teaching activities, the creation of accounts for distance learning, and the creation of teaching platforms remain a severe problem in the schools in DRC context.

3.3. Analysis of Variations in the Preparation and Integration of ICT into the Curriculum

As described in the methodology, the explanatory variables consist of the location of the institution (x_1), level (x_2), the function of the respondent (x_3), sex of the respondent (x_4), level of education (x_5), age (x_6), location of the institution (x_7). The respondents are also divided into primary, secondary, and higher institutions. The dependent variables are preparation and integration of ICT in teaching. Multiple regression analyses are conducted to determine the relationships between the variables involved in this section.

Table 3. Integration of ICT Tools in teaching.

Niveau d'intégration	Mean	SD
Integration of the computer course	3.29	1.11
Practice of the computer course	3.08	1.19
Use of ICT in teaching	2.70	1.25
Use of WhatsApp, Facebook, Instagram, Skype in teaching	2.40	1.35
Use of ICT in lessons	2.36	1.23
Use of ICT for evaluation of lessons	2.34	1.28
Use of ICT for teaching preparation	2.26	1.28
Use of projector in teaching	2.26	1.40
Use of PPtx	2.24	1.33
Use of videos in teaching	2.09	1.25
Online teaching activities organized	1.91	1.20
Use of online pedagogical interaction software	1.90	1.20
Activities on the teaching platform	1.90	1.17
Creation of a ZOOM/Microsoft Team account	1.85	1.22
Creation of website(s) for online courses	1.84	1.21

After analyzing the data, a multiple correlation coefficient of 0.286 with a coefficient of determination of 8.2% was found as the level of prediction of respondents' readiness to use ICT in education by the independent variables. The prediction is statistically significant [F (7, 424) = 5.384, $p < 0.05$, (S)]. The relative regression equation y is as follows: "Y (Readiness Level) = $40.193 - 0.55x_1 + 10.585x_2 + 0.119x_3 - 2.932x_4 - 0.162x_5 - 0.047x_6 - 3.134x_7$".

With regard to ICT integration, the model shows a multiple correlation coefficient of 0.444 with a coefficient of determination of 19.7% as a predictor of ICT integration by the predictors. The level of prediction is statistically significant [F (7, 424) = 14.864, $p < 0.05$, (S)]. The regression equation is as follows:

"F (ICT integration level) = $31.009 - 0.967x_1 + 19.427x_2 + 0.657x_3 + 0.093x_4 - 0.250x_5 - 0.081x_6 - 2.536x_7$"

When analyzing the relationship between the level of preparation for the use of ICT by the respondents and their integration into lessons, the model resulting from the simple linear regression shows a coefficient of determination of 51% of the level of prediction by the predictors. This prediction is statistically significant [F (1, 439) = 458.557, $p < 0.05$, (S)]. The regression equation is presented as "Y (x_1, x_2, x_3, x_4, x_5, x_6, x_7) = $8.235 + 0.777F$".

4. Discussion of the Results

From the responses of the respondents, we note a very inadequate preparation for ICT, as well as training in Computer Science, awareness, and training in the use of ICT while their use is growing in education not only as a result of the evolution of technology but also because of the Covid context that hits the world. According to research, Cleary et al. (2008) mentioned that schools in developed countries remained better equipped while educational institutions in Africa suffered (Bon, 2010; Shabani, 2014; Okebukola et al., 2020) from lack of technological infrastructure coupled with other challenges. The high score in computer training is due to the efforts made in the DRC through the review of the curriculum, which introduced the computer course in all classes and at all levels of education. Moreover, in some primary schools that do not have enough resources to hire staff in charge of computers, classroom teachers are invited to teach this course (Nduwimana & Sindayigaya, 2023b; Sindayigaya, 2022, 2023). This change has obliged several teachers to undergo in-service training at their own expense to avoid unsuitably (Mperejimana & Sindayigaya, 2023; Ndericimpaye & Sindayigaya, 2023; Sabiraguha et al., 2023). In the same vein, there is also a call from the political and administrative authorities to use ICTs, a call that has become more pronounced to meet the challenges imposed by Covid.

But, in the DRC, it is remarked the absence of adequate training known among many causes of poor ICT integration in education (Buhendwa et al., 2023; Kapingaet al., 2018). This inadequacy between exercise and the new ICT requirements in mediatization and mediation can be seen through the content of the computer course, which remains focused on a massive part of the Microsoft

operating system in programs and training in the DRC. This preparation remains very weak in exploiting software to create distance learning platforms. For Okebukola et al. (2020), members of the secondary school community in these countries, including teachers, students, and principals, were unprepared for the unprecedented demands of moving from a face-to-face to an online education system (David et al., 2023). This is not the case in European countries where there is sufficient technological training of teachers where in addition to mastering essential software, such as word processing, spreadsheets, graphs, databases, browsers, e-mail, file transfer; the training offers the possibility of developing websites and educational software (Coen, 2007). This situation illustrates how African countries, including the DRC, risk not taking advantage of the opportunities offered by the Covid-1 pandemic context.

As for the preparation, the level of ICT integration remains high but insufficient at the level of the computer science course and its practices and the use of ICT in teaching. This can be seen through very insufficient exploitation of social networks such as WhatsApp group, sending notes to students' email addresses and practical work to the teacher through the same channel, monitoring videos, using video projectors and computers, etc. The use of teaching sites also remains at the bottom of the scale. This illustrates a low level of service, not putting the learner at the center of the teaching-learning process (Camacho et al., 2020; Tintiangco-Cubales et al., 2015). This is also in line with the emergence phase of ICT in institutions according to UNESCO, a stage, according to Cleary et al. (2008), where the teacher uses ICT for presentation. ICT is a means to convey the teaching content and far from inducing mediation on the cognitive level in the learner as written by Peraya (2000).

The results also show that as the training cycle increases, so does the preparation and use of ICT. This trend is strongly confirmed with the level of preparation and ICT integration. Indeed, *you only give what you get.* How can a teacher go beyond his limits? Thus, the level of use reflects the preparation of teachers. If we want the game to change, let's give teachers a preparation that gives them all the ingredients to make the sauce to our liking. However, it should be mentioned that Covid came when no one was prepared for it. Thus, each country is making do with the limits of its level of development.

5. Conclusion and Recommendations

This paper set out to describe the levels of ICT readiness and integration in educational institutions in the city of Goma during the Covid period. To achieve this, a survey was conducted in primary, secondary, and higher education institutions among learners, teachers, and school managers. After analysis of the data, it was found that the level of integration of ICTs in educational institutions reflects teachers' level of preparation. The use of ICTs is very insufficient ratio and stops at essential software for processing and presenting teaching content to learners who do not have the opportunity to follow distance education courses,

which their teachers would engineer.

Thus, for the educational system of the DRC to take advantage of the opportunities offered by Covid, it would be crucial to rethink the preparation of teachers for ICT by integrating opportunities for the creation of online teaching platforms, the exploitation of pedagogical interaction software such as the Mentimeter, joypad, padlets, concept board, etc. Carrying out action research to take out the training model is an effective way in developing countries.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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