International Journal of Research Publication and Reviews

Journal homepage: www.ijrpr.com ISSN 2582-7421

Teachers' Instructional Practices and the Implementation of the Innovative Science Curriculum in Public Secondary Schools of the Eastern Region of the Democratic Republic of Congo

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ABSTRACT

Instructional practices play an important role in the implementation of curricula. This study investigated the instructional strategies being used in the implementation of the Innovative Science Curriculum (ISC) of the Terminal Cycle of Basic Education (TCBE) in public secondary schools of the Eastern Region of the Democratic Republic of Congo (DRC). The study further identified whether there was a significant relationship between the used instructional strategies and the implementation of the ISC. The study population was composed of 690 public secondary schools and 1739 science teachers from which 10% was chosen to be the sample of the study. 69 Secondary schools and 174 science teachers of the TCBE were selected to form the sample of the study. 42 secondary schools and 140 science teachers were available to participate in the study. Data was collected using a 4 point Likert scale whose reliability coefficient computed of .787 judged the instrument good to yield reliable results. The treatment of data required the use of descriptive statistics mainly percentages and the Pearson coefficient correlation. The results indicated that there was no significant relationship between the instructional practices used and the implementation of the ISC. The study recommended teachers to diversify their practices to impact students and improve the teaching and learning process.

KEY WORDS: Implementation, Innovative Science Curriculum, Instructional Practices

INTRODUCTION

The government of the Democratic Republic of Congo is engaged in the reform of its system of Education focusing on science. The framework law number 14/004 of February 11.2014 introduced the innovations aimed at transforming the Congolese society. Among the innovations, science and technology were given great consideration in the process of boosting the economy of the country (The government of the Republic of Congo, 2014). According to DIPROMADI (2018), in the course of learning science, students develop: (1) logical mind; (2) creativity; (3) scientific curiosity; (4) initiative; (5) manual ability; and, (6) good use of tools and instruments. John Dewey highlighted the role of logic in the process of problem solving when a felt difficulty is sorted out using the potentialities of surrounding environment (Scott, 2014). Iqbal & Almani as cited in Nandwani et al. (2021), posit that global science education system education need more than factual knowledge that will be transferred to learners. In concrete terms, science should be experiential and practical and teaching and learning process should use constructivist approach that enhances skills, values and understanding of the world. Kruea-In & Buaraphan (2014) researched on enhancing lower secondary school science laboratory process skills and laboratory lesson preparation through a social constructivist-based professional development workshop in the Western Region of Thailand. Participants in the study were thirty -six lower secondary schools science teachers whose lesson preparations and scientific experiments in the laboratory where assessed. The study revealed that teachers skills in the practice of conducting laboratory experiments were adequate; skills were developed though workshops and seminars attended by science teachers. Further, the assessment of teachers' lesson plans indicated an integration of science process skills and the social constructivists' perspectives. The traditional practice of teaching science consisted of cookbook-like manuals where science teachers were generally not required to understand the curriculum but followed the prescriptions of the texts book and laboratory manual and were urged to attain higher achievement of leaners (Kruean-In & Buaraphan, 2014). Current practices of teaching science suggest leaner-centered approaches where the leaner participates actively in the construction of his knowledge using available resources of his local environment (Jonnaert, 2018)

According to the Australian National Board of the Curriculum(2009) at secondary level of education, the learner should master the following process of scientific inquiry: (1) formulate scientific research questions and leading answers or hypothesis; (2) conduct scientific investigations by using appropriate instruments and appropriate tool for data collection; (3) ability to gather data, from different sources, organize them and present them in a scientific pattern;(4) analyze data and use tests of hypothesis based on the available evidence; (5) interpret and explain findings, draw conclusions and present a scientific report.

According to Arokuyu (2012) science subjects can be integrated in concepts and methods of inquiry. The integration gives a holistic view of knowledge to be undivided. As such, there is collaboration between disciplines, and learners are given ability to synthetize and have a complete overview of the learning experiences. The integrated science curriculum uses scientific methods that help leaners adapt and adjust scientific theories to real life to achieve science education aims. These aims include: (1) development of scientific curiosity about natural and technological world; (2) develop skills for making scientific inquiries; (3) develop the ability to think scientifically, critically and creatively and to solve problems individually or collaboratively in science related contexts; (4) use the language of science to communicate ideas and views of science related issues ; (5) make informed decisions and judgments about science related issues; (6) be aware of social, economic, environmental and technological amplifications of science and develop attitudes of responsible citizenship.

The reform of science education was fundamentally based on the approach that would bring about innovations and skills to instill into the learner. DIPROMADI (2018) insists on the role that plays the teacher to implement these innovations. He calls for the active involvement of the learner, that requires to follow steps such as : (1) Assigning an activity to a student which enables him to actively interact with essential knowledge; (2) exposing the student to the bank of essential knowledge embedded in "*Régime Pédagogique*"; (3) assisting the student to see the link between the knowledge and the level of his competency; and (4) to develop an evaluation system based on essential knowledge acquired and the competence level of the learner in the transfer of knowledge.

According to DIPROMADI (2018), in the DRC, science curriculum is divided into three subdomains namely; (1) sub domain of mathematics, comprised of Algebra, arithmetic, geometry and statistic; (2) sub domain of life and earth sciences comprised of botany, zoology and anatomy and, (3) the subdomain of physical science, technology and Information Technology and Communication, ICT.

The subdomain of mathematics helps learner to organize his thoughts and develop higher order thinking skills to solve problems of his own life. The subdomain of Life and Earth Science helps learner discovers the real world around him, and to be aware of his responsibility to understand, respect, protect, transform and preserve it. The subdomain of physical science, technology and ICT, helps learner to understand the laws that governs our universe and acquire scientific methods to find solutions to natural and social problems of humans. Further, he understands the technical processes used to produce food and goods and then apply them to find solutions to problems (DIPROMADI, 2018).

Jonnaert (2018) indicated that the reform of the ISC was based on the concept of holistic education and the situated approach to teaching and learning and the evaluation process. The situated approach encourages the teaching and learning that uses contextualized activities to local realities of each region of the country. Furthermore, instructional materials to be used in the process of teaching and learning are found in the local environment of teachers and learners. The National Board of the Curriculum (NBC) proposed a bank of situations that teachers and students should handle to acquire the desired knowledge and skills, These banks of situations are available in four national languages of the DRC namely Kikongo, Tshiluba,Kiswahili and Lingala. Therefore The National Board of the Curriculum has established guidelines that teachers should follow in the process of implementing science curriculum: (1) French language is used as a medium of instruction ; (2) whenever possible, the teacher should make use of national or local language in teaching and learning of science subjects; (3) there is a synthesis note of the education policy; (4) the entry profile of learners in the TCBE is determined and prior knowledge on which new experiences should be founded; (5) the exit profile of the leaner from the CTBE is determined after a sequence of learning experiences has taken place; (6) the pedagogical system for science learning area of the TCBE focuses on situated approach. The innovative science curriculum is centered on learners' activities and focus on providing teachers with instructional resources for the purpose of improving the teaching and learning.

Therefore, teachers should be provided with; (1) a list of essential knowledge taking into account the weekly workload; (2) the bank of the situations organized into major categories, families of situations, with illustration of examples of solutions; (3) each activity should be linked to a certain skill that the student intends to achieve; (4) an example of a situation is presented after each competence and requires student's activity; (5) a matrix describes all the elements involved in a given activity; (6) the assessment tool to evaluate student's achievement; (3) a general lack of professional training of Science and Mathematics teachers

STATEMENT OF THE PROBLEM

The Innovative Science Curriculum (ISC) was launched in all schools of the DRC in the year 2018 as stated above. According to Munangi et al., (2009), the National Board of the Curriculum (NBC) of DRC tried to find out an appropriate approach that would impact right knowledge and skills into leaners to enable them use available resources of their environment to solve the problems of their daily life. There were four reasons why it was important to reform the outgoing curriculum: (1) The subjects taught were not linked with the real life of learners; (2) the teaching and learning process was theory-based; (3) there was no integration among subjects taught in schools; and, (4) the knowledge-based approach used in education produced graduates unable to transform the society. In addition, Jonnaert (2018) pointed out the result of the recent report (DPSDM4, 2016) indicating that the current program of study of mathematics and science revised in 1980 , was outdated and was no longer suiting the current social, cultural and economic needs of the society. In the same line, the report highlighted the areas of weaknesses of the outgoing curriculum that needed improvement and these include; (1) omission of important content in the textbooks; (2) lack of appropriated instructional material; (3) Pedagogical approaches that do not encourage students to develop a sustained interest in the disciplines, (4) lack of strategies that helps learners discover the meaning and application of learned materials; (5) a general lack of professional training of Science and Mathematics teachers. Therefore, this study intended:

1) To find out whether science teachers were using recommended instructional practices to teach science in secondary schools of DRC

2) To determine the level of implementation of the ISC in secondary schools of the DRC

3) To determine whether there was a significant relationship between the instructional practices used and the implementation of the ISC in secondary schools of DRC

4) To find out new ways that would improve the implementation of the ISC in secondary schools of DRC

HYPOTHESIS

This study tested the below hypothesis:

Ho: There is no significant relationship between the instructional strategies and the implementation of the ISC in secondary schools of DRC.

METHODOLOGY

The study involved 690 secondary schools and 1739 science teachers of three provinces of the TCEB of Secondary schools in the Eastern Region of DRC namely province A, province B and province C. According to Metler and Charles (2008) in survey studies, a common recommendation is to sample approximately 10 to 20% of the population. Therefore, the researcher selected 10% of schools and science teachers to be involved in the study. The table 1 below presents schools and science teachers population; school sample size, science teachers sample size and the respondents who returned the questionnaire based on province distribution.

Table 1

Population Distribution of Schools, Science Teachers and sample size

Province	Schools*	10%	reached Schools	Science teachers	10%	Teachers who Returned Questionnaires
Maniema	151	15	8	370	37	33
North-Kivu	324	32	18	799	80	66
South-Kivu	223	22	16	570	57	41
Total	698	69	42	1739	174	140

Source : EPSP, (2020), Researcher's Computation

*The schools are not computed in the total population

. The table 1 above indicates that the study involved a sample of 69 secondary schools where 15 were locate in province A, 32 in province B and 22 in province C. To sum up 42 out of 69 schools expected schools to participate in the study only 42 making 60.86%. Likewise, the study involve d 174 science teachers were 37 were located in in province A, 80 in province B and 57 in province C. Further the table shows that out of 174 science teachers 140 making 80.45 % returned the questionnaire where 33 were located in province A, 66 in province B and 41 in province C. The questionnaire instrument was composed of ten items. Teachers were asked to rake their instructional practices at 4 point Likert scale as follows: (4), always (3), (2) usually rarely or (1) Never.

The reliability of the research instrument was determined by the pilot study that was conducted in one province of Southern region involving 33 science teachers of two public secondary schools. The data was collected, analyzed and computed using SPSS. The Cronbach alpha reliability coefficient of .787 judged the instrument good in yielding reliable results. This was in agreement with Cohen, et al., (2007) who suggested that a reliability coefficient of .70 or higher is judged good to yield reliable results. The items of low reliability removed before the process of data collection. The descriptive statistics were used to compute means and the standard deviation, the hypothesis of the study was tested using the Pearson Coefficient Correlation Analysis (Cohen, et al., 2007).The researcher ensured respondents that the information collected was used for the purpose of this study only. Respondents were not coerced or bribed to be part of the study. Only those who expressed their willingness were involved in the study. Respondents were not required to write their names on the questionnaires neither their identity was revealed during the interview process, unless they wanted to do so. Likewise, in the report participants to the interview and the entities such provinces were assigned codes to ensure the anonymity. The set of this information was written on all the questionnaires and was verbalized to the respondents by either the researcher or his assistants.

RESULTS AND DISCUSSIONS

This subsection presents the findings and the discussion of those findings. The findings are presented in tables of mean percentages and correlation coefficients.

Science teachers' usage of instructional strategies

Table 2

Science Teachers' Usage of Teaching practices

Aspects	Mean	SD
Verification of students' prerequisites	2.98	.95
Presentation of a situation	2.85	.86
Organization of students in group of activities	2.89	.79
Students' utilization of instructional materials	2.64	.79
Students' problem solving skills	2.83	.88
Students 'with individual needs care	2.62	.97
0ral presentation of student's work	2.69	.95
Students make summary of subject matter covered	2.75	.90
Students outcomes evaluation	2.87	.90
Students home works	3.03	.82
Overall mean of use of instructional strategies	2.82	,88

SD= Standard Deviation

Scale of interpretation :(1) 0.00-0.99 Never; (2)1.00-1.99: Rarely; (3) 2.00-2.99: Usually (4) 3.00-3.4.00: Always

The findings expressed in table 2 above showing the overall mean (M=2.82) falling in the category usually, indicate that science teachers usually use the recommended teaching practices in carrying out science subjects. The Standard Deviation (SD= .88), indicates that there was a variability among respondents on one or another practice.

Further the findings in the table above show that the practice of giving home works to students scored higher (M=3.03) falling in the category of always used. This make 75.75% on 4 point Likert scale with implication that science teachers make use of this practice to the daily basis and parents are involved in helping their children to perform homework. Researchers (Mirzanoet el., 2001) posit that when parents help their children with homework, they interfere at the same time with students learning. Teachers should caution parents to avoid solving problems of homework of their children; rather, they should guide them to work responsibly. Further, Mirzano et al. (2001) clarify that parents should be aware of the purpose of giving homework namely: (1) to give students opportunity to practice skills; (2) to prepare students for a new topic; and (3) to elaborate on introduced material.

The use situated learning approach scored (M=2.85), which makes 71,25% on 4 point Likert scale indicating that despite the variability in teachers responses expressed by the standard deviation, science teachers make use of this approach in the teaching and learning process . Researchers (Özüdoğru , 2017) found out that students' perceptions on the use of situated approach was positive which means that science teachers were encouraged to continue with this practice of using situations in the teaching and learning science.

Student's utilization of instructional materials strategy was the second to score low on the list of instructional strategies (M=2.64). This represents 66%o of teachers who make use of this practice. Ngao and Kirimi (2023), support that the availability of instructional materials contributes to the implementation of educational programs. Further, Ngao and Kirimi found out that there was a significant relationship between the use of instruction materials and the implementation of the Competence- Based Curriculum. Most important is the way students make practical work using available instructional materials

Problem-solving highly needed in mathematics and science scored (M=2.83 and SD=.88) which represent 70.75% on 4 point Likert scale indicating that majority of teachers make use of solving in their instructional practice . The standard deviation indicates that there was a variability among respondents , meaning that there were teachers who did not make use this strategy in the teaching and learning science. According to Zhou and Cayaban (2024) in the study on problem solving strategies in Mathematics in primary and secondary school levels in China, highlighted the need of using problem- solving skills to enable students apply what they have learned to real-life problems. The government of China urged teachers to move from traditional approach of teaching basic concepts and algorithms to the solving problem approach that would develop thinking ability to adapt to the current trends of the society. On another note, Graig-Hare (2011) studied grouping students' strategies in technology environment in the USA. The study found out that there was a need of enhancing grouping strategies as one of ways of developing social skills in solving problems. According to Marzano& Brown (2009), problem-solving skills call for experimental inquiry where students should be taught to make predictions based on observations and to design ways to use to test that prediction. Adeleke (2023) recommended various strategies that would promote problem solving into the learners and these include: (1) project-based learning which enables students develop creativity, collaboration, communication and critical thinking skills, (2) experiential learning which involves learning through experience and enables learners develop problem solving skill and adaptability to new situations; (3) cross disciplinary integration which enables students to learn through experiences from others in a collaborative way; and (4) technology integration that enables students develop adaptability and problem-solving skills.

Organizing students in small group of activities (M=2.89) was found to be the second best used strategy by science teachers. In this regard, Gafney & Varma-Nelson (2008) encouraged teachers to make use of Peer- Led Team Learning (PLTL) as a practice that advances student achievement through a peer learning in a peer-led workshop. In the PLTL students are assigned in small groups of six to eight led by carefully selected peers. Students meet in workshops of one and half to two hours to discuss specific topics that deepen lectures and textbooks content in the purpose of developing critical thinking and problem solving skills. Most importantly, the workshop pushes students to accomplish more than they could do individually and reach a higher level of understanding as they are more engaged and accountable to their success. Dean et al. (2012) suggest that when students work in small group they are taught to be engaged in reciprocal teaching. In this technique, students are asked to summarize the group work and generate questions that will enable them deepen the learned information.

Among the practices, one dealing with students' individual needs scored low (M=2.62). However Stronge (2007) suggested that effective teachers tend to recognize individual difference among groups and accommodate that difference in their instruction. Learning experiences should be carefully selected and the classroom setting should be adapted to students with specific needs. Strong continued to insist on the use of scaffolding approach of instruction that allows student to receive the help they need and to work to their own pace.

The practice of helping students make summaries of learned materials scored (M=2.75). Past studies encouraged teachers who help their students make summaries of lessons learned in the classroom. For example, Marzano et al. (2001) highlighted that students understand well the material when they are able to summarize them. In order to best summarize a single paragraph or a portion of materials, Marzano et al. (2001) suggest the following steps: (1) take out material that is not important for your understanding; (2) take out words that repeat information; (3) replace a word of things with a word that describes the things in the list; (4) find a topic sentence and if you cannot find a topic sentence make one up. Dean et al. (2012) mention summarizing technique deepens student's understanding and note taking skill.

Evaluating students 'work scored (M= 2.89), meaning that teachers usually evaluate works of their students. However, the standard deviation of .90 closer to 1 on 4 point liker scale indicates that there was variability among teachers on this instructional practice. Evaluating student outcomes have become a focus of current approaches of teaching and learning. Ho& Ha (2025) clarifies that in comprehensive reform of education, it is critical to understand students stand point on each course they have in the classroom particular for higher grades of secondary schools.

The instructional practice of asking students present the result of their work orally was among the three last scores (M= 2.69). This means that teachers still need to enhance their capacity on how to help students present individually or in small groups their findings. To make this clear, Dean et al (2012) suggested that teachers should ask students to explain the process of scientific inquiry how they come up with their result of a given task. Further, Dean et al.(2012) recommended the following guidelines that would help students successfully present the results of their work: (1) provide students with templates for reporting their work, highlighting the area in which they are expected to provide explanation; (2) provide sentence frames for students that help them articulate their explanations; (3) ask students create audio recording in which they explain their hypotheses and conclusions; (4) provide or collaboratively develop rubrics that identify the criteria on which students will be evaluated; (5) provide opportunities for students to create graphic organizers that help them make sense of the material; (6) establish events at which parents or community members can ask students to explain their thinking. Ati & Parmawati (2022) explained the benefits of developing oral presentation skills in the classroom as one of the formal communication process that convey information to the group. Ati & Paramawati pointed that this is one of trusted learning methods that help students improve their speaking skills. In this technique, teachers ask students to explain a topic in front of the class using power point slides when they assigned in groups of activities.

Implementation of the Innovative Science Curriculum

In this subsection the researcher presents the findings of the ISC. Data are presented in frequency and percentages of different levels of implementation.

Table3

Science Teachers' Level of Implementation of the ISC

Level	Description	Frequency	%
1	Non-use	6	4.29
2	Orientation	20	14.29
3	Preparation	5	3.58
Sub-total non-use level	**22.16%**		
4	Mechanic use	11	7.85
5	Routine	24	17.14
6	Refinement	50	35.71
7	Integration	21	15.00
8	Renewal	3	2.14
Sub-total-use level	**77.84%**		
Total			

Table 3 above which indicate the levels at which science teachers had attained in the implementation of the ISC, shows that 77.84% of science teachers are implementing the ISC, only 22.16% are not implementing it. This means that majority (77.84%) of science teachers in secondary schools have understood the new science curriculum and are in the process of imparting right knowledge to students.

Nevertheless, there is more room for improvement within the implementing groups since only 2.14% have attained the highest level of implementation-Renewal.

Based on the levels of implementation, 6 or 4.29% of science teachers accepted that they implemented the innovative science curriculum at the first level corresponding to non-use indicating that they have little knowledge about the innovative science curriculum and they are doing nothing towards becoming involved unless they are guided by someone; 20 or 14.29 indicated to have attained the second level of orientation demonstrating that teachers have the information of the ISC , have explored its value and its demand on students and the entire school system. Few science teachers, 5 0r 3.58% have reached the third level of implementation of preparation, meaning that they have acquired the information about the ISC and are prepared to use it for the first time; 11 or 7.85% have made an effort to reach the mechanical level of implementation meaning that teachers focus on short time day to day use of the information of the ISC with little time of reflection.

The findings in the table 1 above indicate also that 24 0r 17.14% of science teachers stated that they were implementing the ISC at the routine level signifying that the use of the information of ISC is established and few changes are being made and there is little improvement in their teachings duties; 50 or 35.71% have reached the refinement level and 21 or 15% the integration level of implementation.

Relationship between Science Teachers Usage of Instructional Strategies and the Implementation of the ISC

In this subsection the researcher presents the results of the correlation between the instructional practices being used in secondary schools and the implementation o of the ISC

Table 3

Relationship between Usage of Teaching Strategies and the Implementation of the ISC

Aspects of teachers' usage of materials	r	sig.
Verification of students' prerequisites	.045	.600
Presentation of a situation	.-097	.253
Organization of students in groups	.042	.619
Students' utilization of instructional material	.037	.662
Students' problem solving skills	-.003	.973
Care of students with needs	-.106	.211
Students presents the results in plenary	.126	.138
Students make summaries of the lessons	.004	.960
Students' outcomes evaluation	.089	.294`
Students home works	.105	.216
Teacher's usage of strategies and implementation of the ISC	.034	.694

**significant at the $\alpha = .01$ level *significant at the $\alpha = .05$ level

The findings in table 2 above express a Pearson Correlation Coefficient of .034 and a p-value of .694 greater than ($\alpha = .05$), level of significance. This indicates that the null hypothesis stating that there is no significant relationship between teachers' level of usage of instructional strategies and the implementation of the ISC is accepted. Therefore, the findings suggest that the instructional strategies used by science teachers to carry out the science curriculum were not helping them in the implementation of science curriculum. However, Bibon (2022) in a research on teachers' instructional practices and learners' academic achievement in science found out that there was a high relationship between instructional delivery practices and student's academic performance. Also, a moderate correlation was found between the practices of students' assessment and the academic performance of learners. It was recommended to enhance teachers' capacity through in-service training as a way of helping them to use a variety of teaching strategies including Information Communication Technology (ICT) that would increase student' academic achievement which was evaluated below the expected standards of the Filipino national policy. On another hand, Cains (2019) found that there was a negative relationship between instructional practices of teachers and student' achievement in an Inquiry-Based Learning environment. This means an increase in the instructional practices used would imply a decrease of students 'achievement.

CONCLUSION

The study investigated sciences teachers' instructional practices in public secondary schools of the Eastern region of the Democratic Republic of Congo. The findings science teachers were usually using recommended strategies including: (1) verification of student' prerequisites; (2) presentation of the situation; (3) organizing students in small group of activities; (4) student 'utilization of instructional materials; (5) student ability to solve problems; (6) ability to care individual needs of students; (7) ability of students to present the results of their research in plenary; (8) students ability to make summaries; (9) ability to verify learners outcomes; and (10) giving home work to students.

The study did not found any significant relationship between the instructional being in use in the schools and the implementation of the Innovative Science Curriculum.

RECOMMENDATION

Science teachers were encouraged to continue with current instructional practices and to enhance their competences on how to deal with students individually to allow each student learn at his own pace.

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